AIR CONDITIONING HEATING AND VENTILATING

NOVEMBER, 1958—55th Year

Two Refrigeration Units Serve Chilled Water System for Group of Four Buildings, Los Angeles, Calif.

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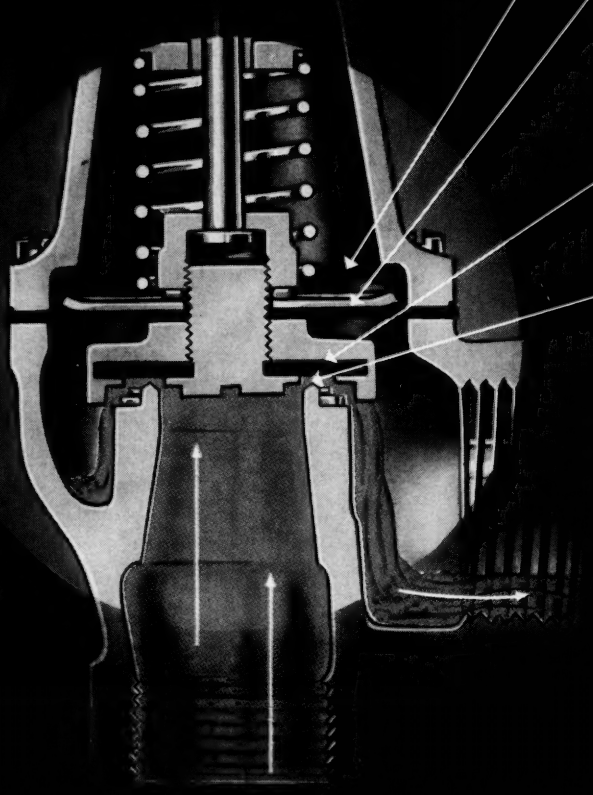
WHAT DO YOU LOOK FOR IN ASME PRESSURE SAFETY RELIEF VALVES?



Double-Safe Design — chanical guides—not diaph operated.

Water Seal — Provides pre alignment of seal to disc eliminates need of hazard mechanical guides which stick or freeze a valve shut lime or corrosion. Seal also tects spring working parts water or steam during re

Stickage-free Disc-to-Meta ing — heat resisting, stic proof silicone disc materi

Pop Action Operation—All A.S.M.E. rated relief valves erate by pressure exerted rectly against the disc to the valve wide open for s relief. The full rate of disch is immediately reached at set opening pressure and d not depend on further pres accumulation as in some o designs.

ENGINEERING DESIGN

The most advanced design in A.S.M.E. rated pressure relief protection for hot water boilers is the new *Double-Safe* design of Watts Valves.

These are water pressure relief valves with an *emergency* steam rated pressure safety relief feature. They will discharge excessive water pressure created by thermal expansion and also excessive steam pressure in the event of emergency temperature conditions.

FULL SELECTION OF SIZES

Watts offers the most complete line of boiler safety relief valves with the 174A Series and 74A-740 (expanded outlet) Series. Designed to meet the smallest or largest requirements for pressure protection from one line of valves, Watts A.S.M.E. Rated Relief Valves furnish complete protection for the great majority of hot water heating and supply boilers *with a single valve.*

Watts Regulator Company • Lawrence, Massachusetts

Watts A.S.M.E. Rated Pressure Relief Valves are available in capacities from 500,000 BTU/HR to 14,370,000 BTU/HR with valve settings from 30 to 150 lbs.

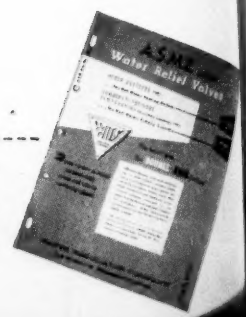
Be on the safe side with

WATTS

Protection and Control Specialties

For complete Specifications,

Ratings, and Application Information on Watts A.S.M.E. Rated Valves, see your wholesaler or send for Bulletin F-ASME.



When It Comes to Humidification . . .

Here is some information to consider:

Automatic Armstrong Steam Humidifiers give large humidifying capacity at low cost —by discharging clean, dry steam directly into room atmosphere, or into the air stream in ducts or plenums. Control is by accurate humidistats. Connections are made directly into steam supply and return lines, and to 110 or 220 volt electrical circuits.

Pneumatic controls also are available.

Advantages of Armstrong Steam Humidifiers

1. Uniform, Accurate Control. Armstrong Steam Humidifiers give humidity control throughout the room to within 2 to 4% of humidistat setting.

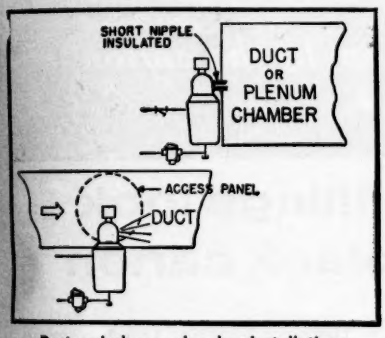
2. No "Fall-out" of Water or Mineral Dust. No water droplets come out of an Armstrong humidifier because the inner chamber is steam-jacketed to evaporate any condensation. And, dry steam leaves no mineral residue to settle out of the air.

3. Easy to Install. Installation of units is similar to that of unit heaters. For simple duct and plenum installations, see Fig. 2.

4. Dependable Quality, Minimum Maintenance. Fan motor bearings are oilless type . . . never need lubrication. Solenoid coils are glass wound. Valves and humidistats are designed for years of service. Simple; sturdy construction means minimum maintenance.

5. Moderate Initial Cost. Mass production and simplicity of design provide a high-quality unit at a moderate price.

6. Low Operating Cost. The cost of steam for humidification to 50% relative humidity at 70°F. averages no more than 1c per 1000 cubic feet of space for a 24-hour day. And the load on the boiler is no greater than the heating load required to evaporate a water spray. The cost of electricity for the fan is as little as ¼ cent per day where the rate is as high as 3 cents per kilowatt hour.



Duct and plenum chamber installations

RECOMMENDED HUMIDITIES FOR VARIOUS TYPE ROOMS

Room	*% RH*
Offices, Schools (Health & Comfort)	35-45
Libraries (Protection of Books)	50
Hospital Croup Rooms	90
Static Control	50 or more
Paper Fabricating	40-50
Wood Processing	35-50

Types Available

ELECTRICALLY OPERATED:

Types C-2 and C-3—These two humidifiers are identical except for size and capacity. The C-2 lists at $170 complete (with fan, humidistat, strainer and steam trap); its capacities for various conditions are listed in the table below. The C-3 (list price $295 complete) has a capacity more than double that of the C-2.

Type VC-2 and VC-3—Similar to C-2 and C-3, but without fans, relying on the velocity of the steam jet for dispersion. At pressures from 5 to 15 lbs. a venturi nozzle is provided. VC-2 lists at $145, VC-3 at $259.50.

Type MC-2—This unit is not automatic, having a manual shut-off valve. List price is $105.25 with venturi, $132.75 with fan.

Type CK-4—A large capacity unit for connection to central heating ducts or large floor-type unit heaters. Automatic humidistat control. Capacity is 6 to 16 times as great as the C-2, depending on pressure. List price is $545.

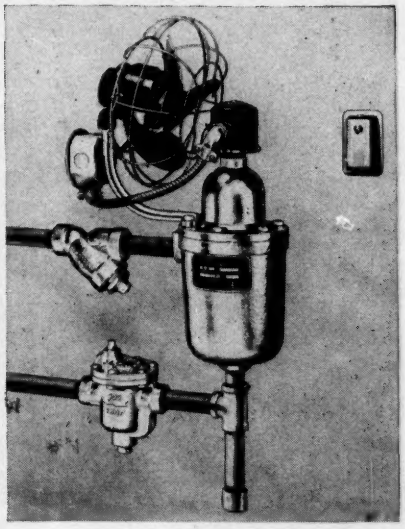
AIR OPERATED AND CONTROLLED:

Types DA-32, DA-33 and DA-34—just like the C-2, C-3, and CK-4 but with pneumatic humidistats and air-operated valves.

C-2 CAPACITIES

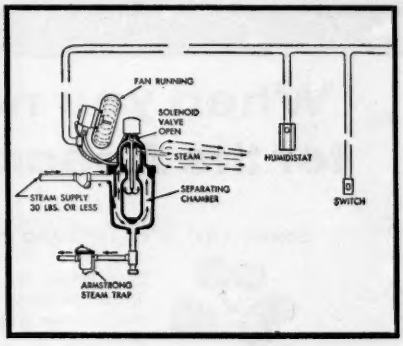
(Maximum cubic feet of space humidified by one Armstrong C-2 Humidifier at 75°F indoor temperature and 0°F, 75% RH outdoors—2 air changes per hour)

Steam Pressure At Humidifier	Humidifier Capacity Lbs./hr.	Relative Humidity To Be Maintained							
		35%	40%	45%	50%	55%	60%	70%	80%
5	42	49,000	43,000	37,000	33,000	30,000	27,000	23,000	20,000
10	60	70,000	61,000	54,000	48,000	43,000	39,000	33,000	29,000
20	65	77,000	66,000	58,000	52,000	47,000	42,000	36,000	31,000
30	76	90,000	77,000	68,000	60,000	54,000	50,000	42,000	36,000



HOW THEY WORK

When relative humidity drops slightly below desired level, humidistat activates solenoid valve, which admits steam into separating chamber and thence to room atmosphere. Fan helps disperse steam. When relative humidity reaches desired level, humidistat closes valve and stops fan.



For Details, Prices and Assistance

Your local Armstrong Representative will be glad to give you complete details and prices, and help you survey and plan your humidification job—at no cost or obligation on your part. Or you yourself can make the survey, with the help of information given in Armstrong Bulletin 500.

For Complete Information

SIXTEEN-PAGE BULLETIN NO. 500 contains a wealth of information about humidification. Tells: how relative humidity affects products and your profits . . . other effects of relative humidity . . . recommended humidities for various operations . . . advantages of Armstrong Steam Humidifiers . . . how present users have profited . . . complete data and prices on all Armstrong humidifiers . . . selection and installation data. To get your copy, just call your local Armstrong Representative or write

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Three Rivers, Mich.

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COMPLETE RANGE OF TYPES AND SIZES

Brass Fittings for Flared Tubes. In all standard combinations, nominal sizes from 1/8" through 3"

Wrought-Copper Solder-Joint Fittings. Nominal sizes 1/8" through 4"

Flanged Fittings. In sizes to meet all standard requirements

Accessories. Hangers, Flanging and Sizing Tools, Tube Straps

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Wrought-Copper Solder-Joint Fittings for Refrigeration and Air Conditioning use. Actual OD sizes 3/16" through 4 1/8"

Cast-Brass Solder-Joint Drainage Fittings. In all standard combinations from 1 1/4" through 8"

Designed for your convenience, the new Anaconda carton serves as a handy container on the job, in your truck or in the stock room. Contents are clearly indicated so you can quickly spot the fittings needed.

These new cartons are being placed in the hands of Anaconda distributors as quickly as possible, but whether in the new package or not, Anaconda Fittings are the best you can buy. On your next copper job, use products that you can depend on—use Anaconda Copper Tubes and Anaconda Fittings.

HAVE YOU OUR CATALOG, "Anaconda Copper Tube Fittings and Valves"? If not, write for a copy today. It lists, with illustrations and roughing-in dimensions, the complete range of Anaconda Fittings in sizes from 3/16" through 12" for all copper tube applications—general plumbing, heating, air conditioning and refrigeration. Ask for Anaconda Publication C-12. Address: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario, Canada.

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AIR CONDITIONING HEATING AND VENTILATING

Volume 55, Number 11 **November, 1958**

THE COVER

Two 600-ton hermetic centrifugal refrigeration units supply chilled water for cooling a four-building group of Pacific Mutual Life Insurance Company, Los Angeles, Calif. Photograph, courtesy of The Trane Co., La Crosse, Wis.

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EDITORIAL STAFF

EDITOR
Clifford Strock

ASSOCIATE EDITORS
Nathan N. Wolpert
William B. Foxhall
Harold M. Englund
Richard L. Koral

ADVERTISING REPRESENTATIVES

NEW YORK 13
Harry J. Twine
George W. Miller
93 Worth Street
CAnal 6-8120

CLEVELAND 12
Edward B. McEntee
17115 Hillsboro Rd.
IVanhoe 1-6857

CHICAGO 1
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BIRMINGHAM 9
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1201 Forest View Lane
TRemont 1-5762

DALLAS 18
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9006 Capri Drive
DAvis 7-3630

LOS ANGELES 57
Robert H. Deibler
1800 W. Sixth St.
HUbbard 3-0303

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A new gas-fired absorption refrigeration system shows a 50% improvement in coefficient of performance, a 30% reduction in fuel consumption, and a 25% reduction in cooling water requirements, according to Southwest Research Institute, San Antonio, Tex., where the unit was invented and developed in a 2-year research program for the American Gas Association. Announcement was made by Drs. Eugene P. Whitlow, chairman, Dept. of Chemical Engineering, and Judson S. Swearingen, technical director, Petroleum Technology, both of the Southwest Research Institute, in a paper read at a meeting of the American Institute of Chemical Engineers in Galveston.

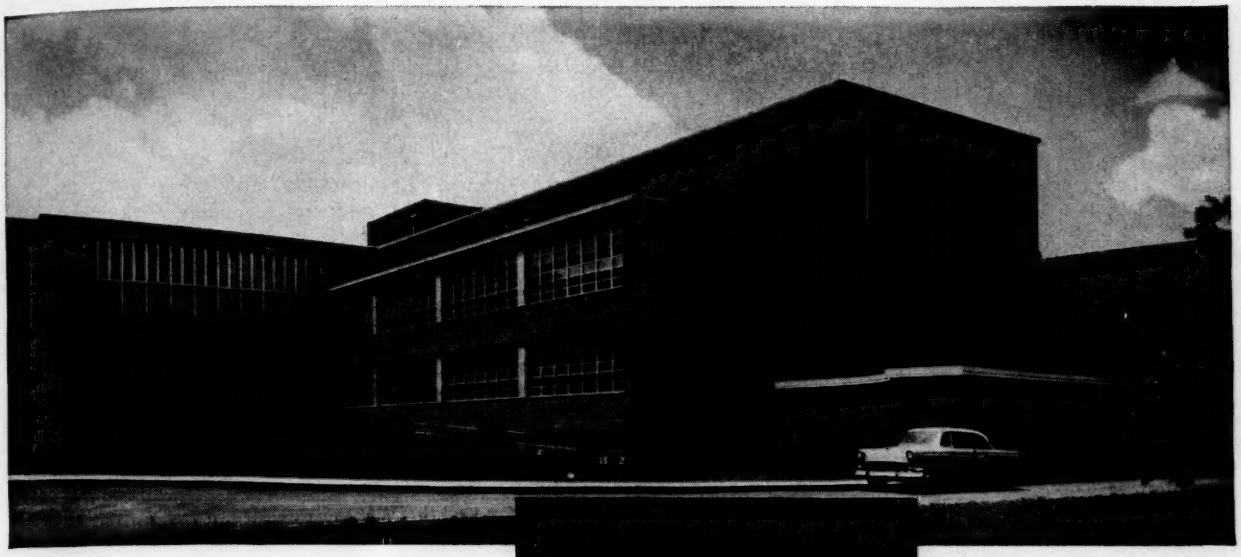
A roster of some of the nation's leading architects, engineers, building research directors, and educators has been assembled to act as a Speakers Bureau for Building Research Institute. Organizations planning national or regional meetings in the near future are invited to request further details from Mrs. Edith Geiger, BRI Speakers Bureau, Building Research Institute, 2101 Constitution Ave., Washington 25, D. C. Speakers have volunteered their time but require travel and subsistence expenses.

Two lease plans for air conditioning systems have come to our attention. One, announced by Typhoon Air Conditioning Co., Brooklyn, N. Y., provides 2-, 3-, and 5-year leases with option to renew at the end of the lease. Complete building system designed for the particular building without investment in equipment or installation work is offered. Hudik-Ross, Inc., mechanical contractor of New York City and Hackensack, N. J., has its own plan. It will be applicable to mechanical contracts in virtually every type of structure. Entire heating and ventilating systems, including piping, sheet metal and electrical work, as well as complete central cooling systems, will be leased, and the company is prepared to provide mechanical installations under its lease plan anywhere in the northeastern United States. Base period is 2 to 7 years, with unlimited renewal periods.

A robot coal miner, operated by a man at an electronic control center, will be commercially available within 18 months from Joy Manufacturing Co., Pittsburgh, Pa. Peabody Coal Company has operated one of the prototype machines for several months at three of its mines. A continuous mining machine, the unit is equipped with sensing elements which tell the operator outside the mine whether the machine is properly heading into deposits of coal. Machine was developed by Union Carbide Olefins Co., a division of Union Carbide Corporation.

A survey of costs of school building made by the National Education Association indicates that in 20 years the cost of school buildings has increased only 150%, while all buildings have gone up 210% in cost. Medium priced brick residences have increased 225%, medium priced frame residences, 228%, and general construction, 275% in the same period. Cost of structural steel has advanced 215%, face brick 200%, common labor 330%, and skilled labor, 220%. Careful planning and elimination of architectural gingerbread, lowering of ceilings, and elimination of much hand labor is responsible for the relative economy in school construction, according to Libbey-Owens-Ford Glass Company, which believes that more extensive use of glass has contributed to this economy by facilitating the abandonment of the tall institutional type school of a few decades ago. Window glass, it says, is 59% above 1926 prices, plate glass 2% below what they were 31 years ago.

And in Cincinnati – A FUTURE OF FAULTLESS SERVICE



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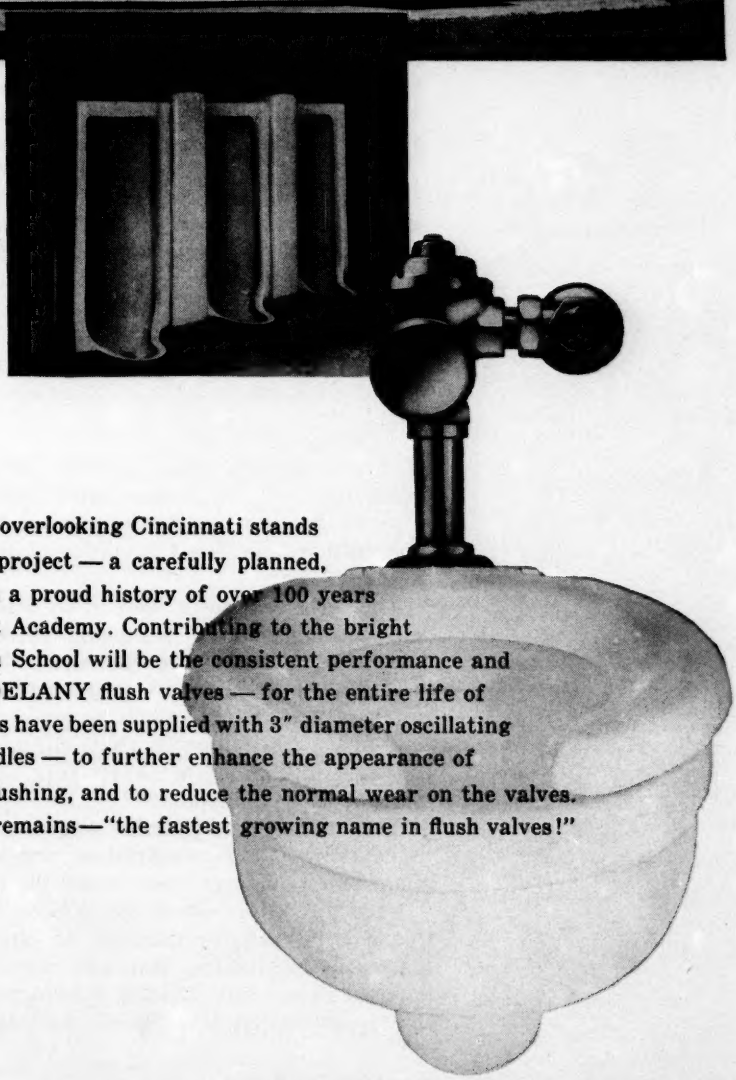
plumbing fixtures manufacturer



On the high point of a hilltop overlooking Cincinnati stands this prized COYNE & DELANY project — a carefully planned, contemporary school with a proud history of over 100 years as the former Mt. St. Vincent Academy. Contributing to the bright future of Seton High School will be the consistent performance and freedom from maintenance of DELANY flush valves — for the entire life of the building. Here, DELANY valves have been supplied with 3" diameter oscillating discs in lieu of lever handles — to further enhance the appearance of toilet rooms, to facilitate ease of flushing, and to reduce the normal wear on the valves. Another reason why DELANY remains—"the fastest growing name in flush valves!"

DELANY *Flush* VALVES

Since 1879

COYNE & DELANY CO. • 834 KENT AVE. • BROOKLYN, NEW YORK

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WASHINGTON OVERTONES

by LORING F. OVERMAN

● With Congress in recess, the principal overtone in Washington is "What can be done about taxes?"

There are several approaches:

U. S. Chamber and National Association of Manufacturers favor a top-to-bottom overhaul of the entire tax system. They contend that the present tax structure penalizes efficiency, rewards mediocrity, and stifles incentive; that progressive reductions will actually increase tax receipts by stimulating business.

Small Business agrees generally with Big Business as to the need for a revised tax structure, but is willing to settle for "half a loaf" right now while working toward a larger share.

Many Washington planners, still convinced that the public treasury is bottomless, continue to dream up new ways to spend.

Defense needs can no longer be controlled by the hopeful device of getting "a bigger bang for a buck." Instead, reports from Cape Canaveral and other buck-launching sites indicate that even the smaller "current bangs" involve bucks numbered into the millions.

Inflation, meanwhile, continues to upgrade all Washington operating costs, with consequent increases in the need for additional revenues. Case in point: the new Federal-State highway fund is expected to be $900,000,000 in the red by fiscal 1960; another billion by 1961. Suggested solution—a three-cent Federal levy on gasoline instead of the present cent-a-gallon tax.

● Taxpayer groups are urging that now is the time for all good members to come to the aid of their pocketbooks. Needed, they point out, is a taxpayer-dictated policy to guide incoming members of Congress, and to serve as a braking action on spending schemes.

Pending clarification of the over-all taxing policy, tax folks in Washington are conducting hearings to uncover inequities and to suggest ways of easing the pain of present levies.

● How to properly define "taxable" air conditioning units under the again-extended excise tax law? Suggestions were made before the Internal Revenue Service at a public hearing in Washington on October 1. The industry's viewpoint was presented by the Tax Committee of the Air Conditioning and Refrigeration Institute.

The ARI committee, headed by Rudy Bert of Copeland Refrigeration Corp., and accompanied by Managing Director George S. Jones, Jr., and General Counsel John H. Pratt, proposed:

—that the Federal 10% manufacturers' excise tax be limited to room air conditioners of 17,000 Btu per hr or less capacity at ASRE standard design conditions;

—that the definition be made effective July 1, 1959;

—that inventories not necessarily be exempted from the tax if the foregoing effective date be adopted.

The Institute's presentation also urged that the Internal Revenue Service make its definition of self-contained air conditioning units clear enough so that unitary equipment would not come under the tax.

Need for ARI to state the industry's position followed a recent IRS decision to amend its ruling on taxability of self-contained units. Heretofore, IRS has held that such units of less than one horsepower are subject to the 10% war-time-imposed excise tax. Despite ARI appearances before Congress, efforts to have the tax eliminated have failed. As long as the tax liability continues, IRS must

(Continued on page 8)

76 Quarts of Actual Water

Permeate the Average Home EACH WEEK...

. . in the form of 152 lbs. of WATER VAPOR

NO WONDER TIMBER ROTS — PAINT PEELS — PLASTER CRUMBLES — STEEL BEAMS RUST!

Here's the breakdown for a family of 4 per week

	VAPOR
Breathing and Perspiring (2 oz. per person per hr.)	51.0 lbs.
Showers (½ lb. per bath)	14.0 lbs.
Washing Clothes	4.3 lbs.
Drying Clothes Indoors	26.0 lbs.
Cooking (Gas) (4.7 lbs. daily)	32.9 lbs.
Ordinary Dish Washing (1 lb. daily, automatic much more)	6.0 lbs.
Mopping (100 sq. ft. daily, 3 lbs.)	18.0 lbs.
TOTAL WEEKLY VAPOR	152.2 lbs. or 76 quarts

In addition, each 1,000 sq. ft. of soil under a building may produce 96 lbs. of water vapor DAILY.

Because vapor has slight density, about 1/205,000th the density of water at 32°F and 1 millionth at zero degree F., it passes through brick, stone, plaster, etc. Most building materials, even asphalt paper, are *porous* to vapor.

When vapor meets a cold front inside walls and ceilings and reaches a dew-point, it condenses. This destructive "fall-out" (condensation), stimulates the growth of the ever-present microscopic spores of fungi in timber that cause dry-rot. Paint peels! Plaster cracks! Masonry crumbles! Iron rusts! Destructive condensation cost over a MILLION DOLLARS in repair bills to one apartment development alone!

Metals are the best vapor barriers because they have almost ZERO vapor permeability. Multiple layers of aluminum interspersed with air spaces, also scientifically minimize condensation formation on or within them; as well as the flow of heat by radiation, convection, and conduction.

When multiple sheets of aluminum stretch parallel all the way from joist to joist, they insulate the entire area with full-depth, *uniform* protection.

Such insulation is available commercially in *continuous* pre-fabricated lengths of 375 to 750 ft. It is installed in ceilings, walls, floors and crawl spaces; between wood beams and studs, steel girders and trusses.

The U. S. National Bureau of Standards has published an informative booklet describing the destruction that condensation can cause, and means of its prevention. It is entitled "Moisture Condensation in Building Walls". Send us the coupon for a FREE copy.

THERMAL VALUES* INFRA PARALLEL INSULATIONS
Non-metallic Insulation Equivalents in Inches†

	UP-HEAT	DOWN-HEAT	Cost§
TYPE 3	C .143=2⅓"	C .046=**7⅕"**	3½¢ sq. ft.
TYPE 4	C .105=**3⅕"**	C .038=**8⅔"**	5¢ sq. ft.
TYPE 5	C .081=4"	C .034=9½"	6¢ sq. ft.
TYPE 6	C .068=4⅘"	C .034=9¾"	7¢ sq. ft.
TYPE 9	C .043=**7¾"**	C .029=**11¼"**	12¢ sq. ft.

Types 1, 2, 7, 8 also available

*Determined by method of National Bureau of Standards in H.H.F.A. Research Paper 32.

†Calculated on basis of limiting thermal values cited in Fed. Specs. LLL-f-321b; HH-I-585; HH-I-521c; HH-I-551a.

§Average installation rate is 2000 sq. ft. per day per man.

CAN BE PURCHASED THROUGH YOUR PREFERRED LOCAL DEALER

Infra Insulation, Inc., 525 Bway., N. Y. C. Dept. V-11
Send "Moisture Condensation in Building Walls."

NAME_____

FIRM_____

KIND OF BUSINESS_____

ADDRESS_____

WASHINGTON OVERTONES *(Continued from page 6)*

administer details, and the ARI action was taken to guide the tax collection service people.

● The air conditioning industry should be well pleased with the resounding pat on the back given by the National Better Business Bureau. Observed the Bureau:

"Our congratulations go to advertisers and advertising media for their efforts which made possible the success of the program to show Btu ratings in the advertising of air conditioners this year. The need of using Btu cooling capacity ratings is well recognized and gained acceptance from both the public and the dealers. Advertisements without the Btu ratings were rare, and the use of 'tons' and 'horsepower' diminished considerably. It is our hope that next year we may see the complete elimination of these misleading terms."

Air Conditioning and Refrigeration Institute is aiding the program in many ways. An important new step is to provide a means of publicizing the new ratings at the buyer level by means of an "ARI Certification Seal." This may be affixed to approved units, but permission for use of the Seal may be withdrawn if random sampling reveals below-par performance.

● Air conditioning industry people are being invited to a conference to study noise problems introduced into commercial buildings by lighter construction, and by such mechanical equipment as high-velocity air conditioning and ventilating systems, among others. The conference, scheduled for January 14-15, will be sponsored by the Building Research Institute, an affiliate of the National Academy of Sciences and the National Research Council.

Information about the conference may be obtained by writing Harold Horowitz, BRI Technical Secretary, 2101 Connecticut Avenue, Washington 25, D. C.

● Current Washington briefs of interest to air conditioning and refrigeration people:

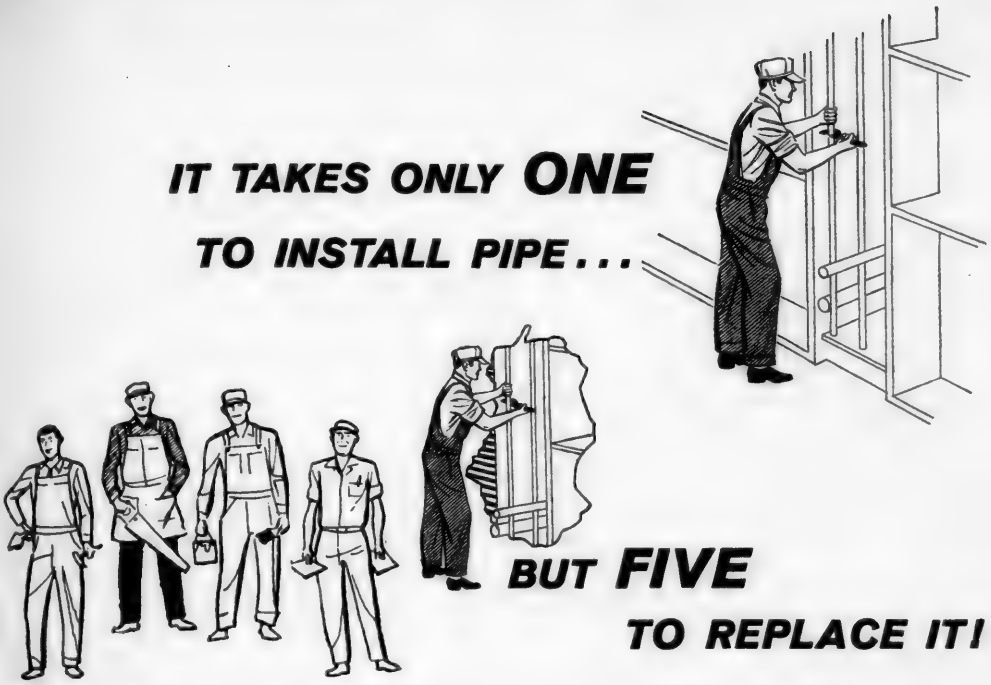
According to Congressional statistics reported by ARI, one of every eight persons employed in the U. S. today is on a public payroll. There are eight-million civilian employees on Federal, state and local government payrolls. Their aggregated paycheck comes to $30-billion per year, and is still rising.

Private home building starts in September reached 108,800, raising the adjusted annual rate to 1,220,000 units—highest for any month in three years. The rate compares with 1,160,000 for July; 1,170,000 for August. For the first nine months of 1958 private housing starts reached a seasonally adjusted annual average rate of 1,054,000 units, compared with an average of 985,000 for the same period in 1957.

To bolster the public housing phase of next year's construction program, Congress will be asked to authorize at least $1-billion additional to support low-cost housing. Rep. Albert Rains (D-Ala.) chairman of the Housing Subcommittee of the House Banking Committee, will sponsor the proposal. Meanwhile, Representative Rains suggested that the Administration release immediately the $400-million in mortgage support funds voted to the Federal National Mortgage Association last April to support low-cost housing. Failure to pass the omnibus housing bill in the last Congress left the agency without new funds.

Representative Rains' insistence upon loosening Federal purse-strings is predicated, he said, upon indications that building starts may be considerably lower next year. Braking factors, he indicated, are higher building costs, higher land preparation costs, higher interest rates, and tightening money at both individual and Federal lending levels.

● First public explanation of plans to implement the new Small Business Investment Act of 1958 will be given December 1-2 in New York City. Senator John Sparkman (D-Ala.), chairman of the Small Business Committee, will discuss small business' needs for long-term credit, and will tell how the new law (PL 85-699) can help meet the needs.



Here's why corrosion costs more than 4-D Wrought Iron

One of the most convincing demonstrations of false piping economy these days, is to witness a pipe repair job where low first-cost material has failed and is being replaced.

The original installation is quickly made by the piping contractor. But the replacement calls for hours of work by as many as *five* craftsmen: plumber, mason, plasterer, carpenter, painter. Often, maintenance is billed at overtime rates. And this is only part of the cost story. Production downtime may amount to far more than the maintenance costs.

The only way to beat this problem is to avoid it. And you can avoid it by using New 4-D Wrought Iron. It is the most versatile material yet developed to help you fight corrosion. It can face corrosive attack with far greater resistance, even, than standard wrought iron.

4-D is tough . . . withstands vibration and shock. It is malleable, can be readily forged, cut, bent, and threaded. Sound, durable welds are easily produced, because of 4-D's self-fluxing action.

Ask the Byers representative to relate the advantages of new 4-D Wrought Iron to your corrosive applications. And write us for recent test data and new 4-D Wrought Iron literature. A. M. Byers Company, Clark Building, Pittsburgh 22, Penna.

BYERS

4-D WROUGHT IRON

TUBULAR AND FLAT ROLLED PRODUCTS

ALSO AMBALLOY ELECTRIC FURNACE STEELS AND PVC PIPE AND SHEET

BRIEFLY STATED

ENGINEERING SOCIETIES

Dr. Thomas Bedford, director of the Medical Research Council, Environmental Hygiene Research Unit, London, England, will present a paper at the Topical Session of the 65th Annual Meeting of the AMERICAN SOCIETY OF HEATING AND AIR-CONDITIONING ENGINEERS, to be held in January. For further details of the meeting, see *News of the Month* department in this issue. In the same department, see also a report on the 52nd Annual Meeting of the AMERICAN SOCIETY OF SANITARY ENGINEERING, which took place in September.

AMONG THE ASSOCIATIONS AND INSTITUTES

Resignation of W. H. Scheick as executive director of BUILDING RESEARCH ADVISORY BOARD (BRAB) and BUILDING RESEARCH INSTITUTE (BRI) was accepted, with regret, by the National Academy of Sciences-National Research Council, of whose Division of Engineering and Industrial Research BRAB and BRI are a part. For the time being, Robert M. Dillon, acting secretary of BRAB, and Milton C. Coon, Jr., BRI secretary, will manage the two groups. The BRI technical program will continue under the direction of Harold Horowitz, technical secretary.

Appointments to serve on the BRAB Advisory Board for five-year terms each have been extended to the following members of the building industry by the National Academy of Sciences-National Research Council: Malcolm C. Hope, chief, General Engineering Program, Division of Sanitary Engineering Services, U.S. Public Health Service; John A. Robertson, manager, Research Dept., United States Gypsum Company; Ira H. Hardin, Ira H. Hardin Company; Robinson Newcomb, Consulting Economist; Glenn H. Beyer, director, Housing Research Center, Cornell University. In addition, J. D. Cochrane Jr., technical director, Formica Division, American Cyanamid, has been appointed to serve a one-year term. Richard H. Tatlow, III, president of Abbot, Markt & Company, Inc., Engineers, has been made vice-chairman of the Board.

J. B. Ogden, vice-president—sales, Airtemp Div. Chrysler Corporation, was reelected chairman of the ROOM AIR CONDITIONER SECTION, NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION, New York, N.Y. L. M. Larkin, general manager, Air Conditioning Div., Whirpool Corporation, was elected vice-chairman of the Section. Mr. Larkin succeeds Paul Augenstein, president of Chrysler Airtemp, as Section vice-chairman. Election of officers followed the announced resignations of Mr. Ogden and Mr. Augenstein as officers of the Section. Their actions were the result of changes made by them in their company affiliations. Mr. Ogden was formerly general manager, Air Conditioning Div., Whirlpool Corporation, and Mr. Augenstein was general manager, Room Air Conditioning Dept., Major Appliance Div., General Electric Company. Reelection of Mr. Ogden to head the NEMA Section was made possible because Chrysler Airtemp is joining NEMA and its Room Air Conditioner Section.

BURGEONING BUSINESS

Russell E. Anderson, Norman Snow, and Ray Rutkowski announce the formation of ANDERSON-SNOW CORPORATION, for the manufacture of standard and custom-built coils. The new line will include heating coils, cooling coils and air handling equipment for use in heating, ventilating, refrigeration and air conditioning systems. The three principals are well known in the field and have had extensive experience in the manufacture of these components. The plant is located at 3863 North Milwaukee Ave., Chicago 41, Ill. . . .

TEMCO, INC., Nashville, Tenn., has acquired the inventory, tools, and dies for production of gas and oil space heaters formerly manufactured by Magic Chef Div., Food Giant Markets, Inc., under the trade mark *Magic Chef*. According to F. Donald Hart, Temco president, his company will continue to manufacture gas and oil room heaters this year under the trade mark *Magic Chef*, and, subsequently, the line will be produced under the trade mark *Magic Chef—Wonder Warm*, which name the company acquired as part of the transaction. . . .

Appointment of WHITSON ENGINEERING CO., 6116 Denton Drive, Dallas, Tex., as a master distributor is announced by U.S. GAUGE DIV., AMERICAN MACHINE AND METALS, INC. Whitson specializes in sales of instruments, controls, and allied engineered products. USG products to be handled include indicating pressure gages as well as temperature and pressure recorders and indicating controllers. . . .

BELL & GOSSETT CO., Morton Grove, Ill., commenced a series of regional educational meetings designed particularly for architects and engineers. The meetings are built around a new design manual, *Zone Control With the B&G System of Primary and Secondary Pumping*. The educational program is conducted jointly by the B&G Sales and Engineering Departments. Commencing with the meeting in Detroit on September 9, other meetings have been scheduled in Minneapolis, St. Paul, Seattle, Portland, San Francisco, Los Angeles, Chicago, Philadelphia, New York City, Boston, Washington, Hartford, Pittsburgh, and Cleveland. Attendance will be by invitation. . . .

FARR COMPANY, national manufacturing engineers of commercial and industrial air filtration equipment, has appointed five new representatives to handle its product line. The representatives and their territories are: AIR FILTER & SERVICE, Sacramento (Northern California and Nevada); R. H. SPARKS, Des Moines (Iowa, Nebraska and Rock Island County, Illinois); R. N. TOUCEY, Pittsburgh (Pennsylvania); AIR FILTER & SALES SERVICE, Kansas City, Mo. (Kansas and Western Missouri); and INDUSTRIAL SUPPLY COMPANY, Syracuse, N.Y. . . .

JOHNS-MANVILLE CORP., New York, N.Y., has proposed a merger with L. O. F. GLASS FIBERS CO., Toledo, Ohio, on the basis of one share of its common stock for two and one-half shares of the glass company's common stock, it was announced by A. R. Fisher, chairman and president of Johns-Manville, G. P. MacNichol, Jr., chairman, and R. H. Barnard, president, of L. O. F. Glass Fibers. L. O. F. Glass Fibers Company, second largest firm in the glass fiber industry, was

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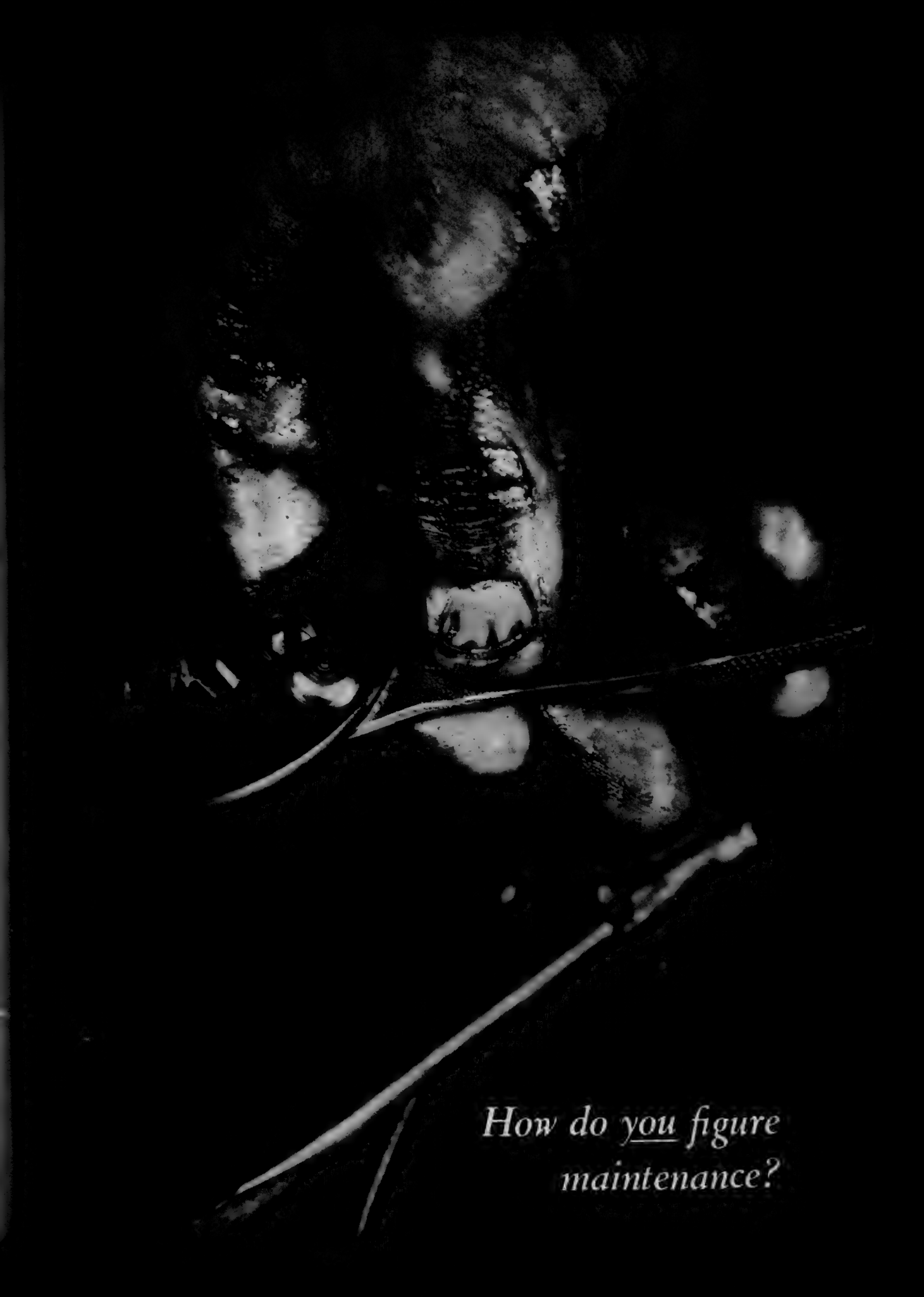
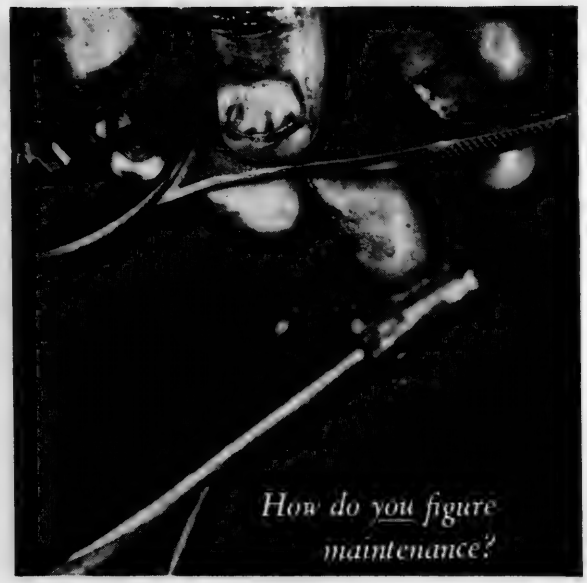

How do you figure maintenance?



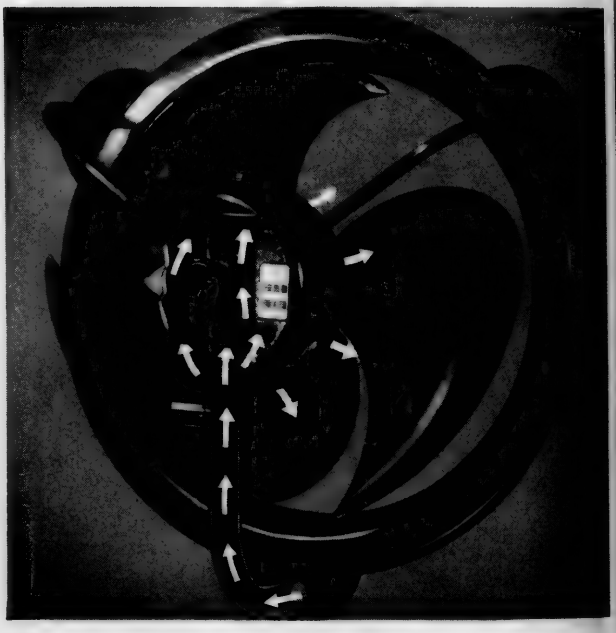
When it's ventilating equipment...

Just exactly what do *you* look for when you're after ventilating equipment? What features stand out in *your* mind as most important? What "makes" Quality Equipment, with a capital "Q"?

We wanted to know, so had an independent research organization conduct a nationwide survey among consulting mechanical engineers.

Here's why ILG *fans and cost so little to maintain*

"X" Marks the Spot where the "traveling" mike is placed to pick up sound waves from this Ilg BC Airfoil Centrifugal Fan. Direct-connected Ilg-built motors eliminate the noisy slip and slap of belts and pulleys. In addition, Ilg Backward Curved Blades and airfoil design cut down eddy currents and turbulence for quieter operation.



How to Have Your Cake and Eat It. With Ilg Propeller Fans you get the operating cost advantages of *open-type* motors plus the protection of *totally enclosed* motors. Vent pipe brings in outside air to *pressure-cool* single-phase permanent-split capacitor and 3-phase motors. Casing protects motor windings against deposits. "One-Name-Plate" guarantee covers *both* fan and motor.

For fans built to satisfy your "specs"...

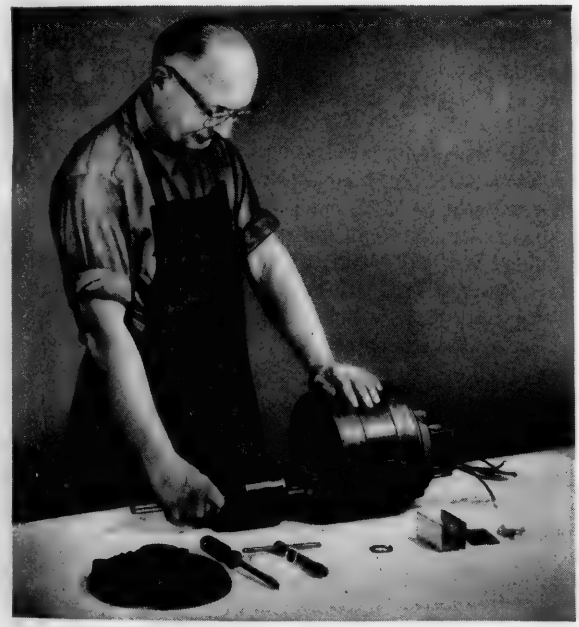
consulting engineers put low maintenance costs high on the list

What did we find out? That *low maintenance costs* were a primary consideration with about three out of every four consulting engineers.

A glance below will show some of the reasons why Ilg fans and ventilators *cut maintenance costs* to the absolute minimum. And don't overlook some of the *other* Ilg strong points preferred by consulting engineers; for example: quiet operation, vibration-free performance, low operating costs.

For further details of why Ilg rates so high with those who specify, send for Catalog No. 153 on propeller fans, Bulletin No. 257 on airfoil centrifugals, Bulletin Nos. 2301 and 2700 on power roof ventilators.

ILG *motors and ventilators operate so quietly*



Last Look You'll Ever Have. Look now—because there's never any need to take an Ilg motor apart later. No centrifugal switches to wear or fail. Double-sealed, permanently lubricated ball bearings plus dynamically balanced moving parts assure smooth operation. Direct drive eliminates belt maintenance. Lower starting torque subjects permanent-split capacitor motor to less initial shock . . . lengthens motor life.

What's Inside Counts, Too. Beneath the lifetime aluminum housing of this low-silhouette Ilg Power Roof Ventilator purrs an Ilg-built motor direct-connected to the super-silent "Q"-type fan wheel. 11 sizes available. Choice of single-phase permanent-split capacitor or 3-phase motors.

specify ILG

ILG ELECTRIC VENTILATING COMPANY
2851 N. Pulaski Road, Chicago 41, Illinois
Offices in 57 Principal Cities
Member of Air Moving and Conditioning Association Inc. (AMCA)

BRIEFLY STATED

(Concluded from page 10)

formed in March, 1955 by the merger of Glass Fibers, Inc., with the Fiber Glass and Corrulux divisions of Libbey-Owens-Ford Glass Company. The origin of Glass Fibers, Inc. goes back to 1944 when it was founded by Mr. Barnard, a well-known glass manufacturing executive, and based on his development of the Barnard Process of electronic-extrusion for making glass fibers. . . .

THE FLINTKOTE COMPANY has arranged to purchase all of the assets and the business of Orangeburg Manufacturing Co., Inc., Orangeburg, N.Y., it was announced jointly today by I. J. Harvey, Jr., Flintkote chairman and chief executive officer and H. J. Robertson, Orangeburg president. Orangeburg will continue under the same management as an independent division, it was announced. Stockholder ratification will be required. . . .

ORR & SEMBOWER, INC., Reading, Pa., manufacturers of packaged boilers, fuel burning systems and other heat exchange and combustion equipment, announced appointment of new sales and service representatives: ENTERPRISE HEAT & POWER CO., 1901 West Roosevelt Road, Chicago 8, Ill.; BARNHART-DWYER CO., 2500 Garfield Ave., S. E., Albuquerque, N. M.; CONE & WALLACE CO., 1325 South 26th St., Phoenix, Ariz.; ROBERT B. STOCKDALE ASSOCIATES, 3115 Buffalo Drive, Houston 19, Tex.; and TODD MACHINERY CO., 140 West Second South, Salt Lake City 1, Utah. . . .

THERMAL SUPPLY INC., Houston, Tex., has acquired the assets from the partnership that owned United Supply of San Antonio, as well as the branches in Austin, Corpus Christi, Harlingen, McAllen and Victoria, all of Texas. Thermal and United will represent the same manufacturers in so far as is feasible. The name of United Supply will continue to be used in a practical manner in the areas where the name has enjoyed excellent relationships with suppliers and customers alike. That is, the change in name will be gradual. The combined companies with eleven warehouse locations will cover an area which includes all of Louisiana; except the Baton Rouge, New Orleans portion, and all of East, South, and Southwest Texas. . . .

SPORLAN VALVE CO., St. Louis, Mo., announces a new organizational structure for its field sales offices. The company's seventeen nation-wide sales offices are grouped into nine geographical sales districts. To head the new areas, nine veteran Sporlan sales engineers will be promoted to district managers. The field offices will continue to function as such but will be under the supervision of their respective district managers.

AMONG THE MANUFACTURERS' PERSONNEL

Pressly H. McCance, former president of Duquesne Light Company, is appointed assistant to the president of EDWIN L. WIEGAND CO., Pittsburgh, Pa., electrical heating manufacturer, with the principal assignment of coordinating the company's relationships with electric utilities throughout the country. Promotion of electric heating for residences, industry, commerce, and institutions is the goal. With utility companies pushing for all-electric living, the industry is said to expect electric heating to expand substantially . . .

Edward W. Legier, vice-president and eastern regional manager, AMERICAN-STANDARD, AMERICAN BLOWER DIVISION, Detroit, Mich., has retired after 35 years of service. J. A. McCain is appointed eastern regional manager; R. C. Wilts, New York branch manager; and H. B. Barron, eastern regional manager, power plant equipment; to replace him . . . New manager of engineering and research for ACOUSTICAL DIV., ELOF HANSSON, INC., New York City, is Edwin S. Bishop. His specialty is vibration and noise control . . .

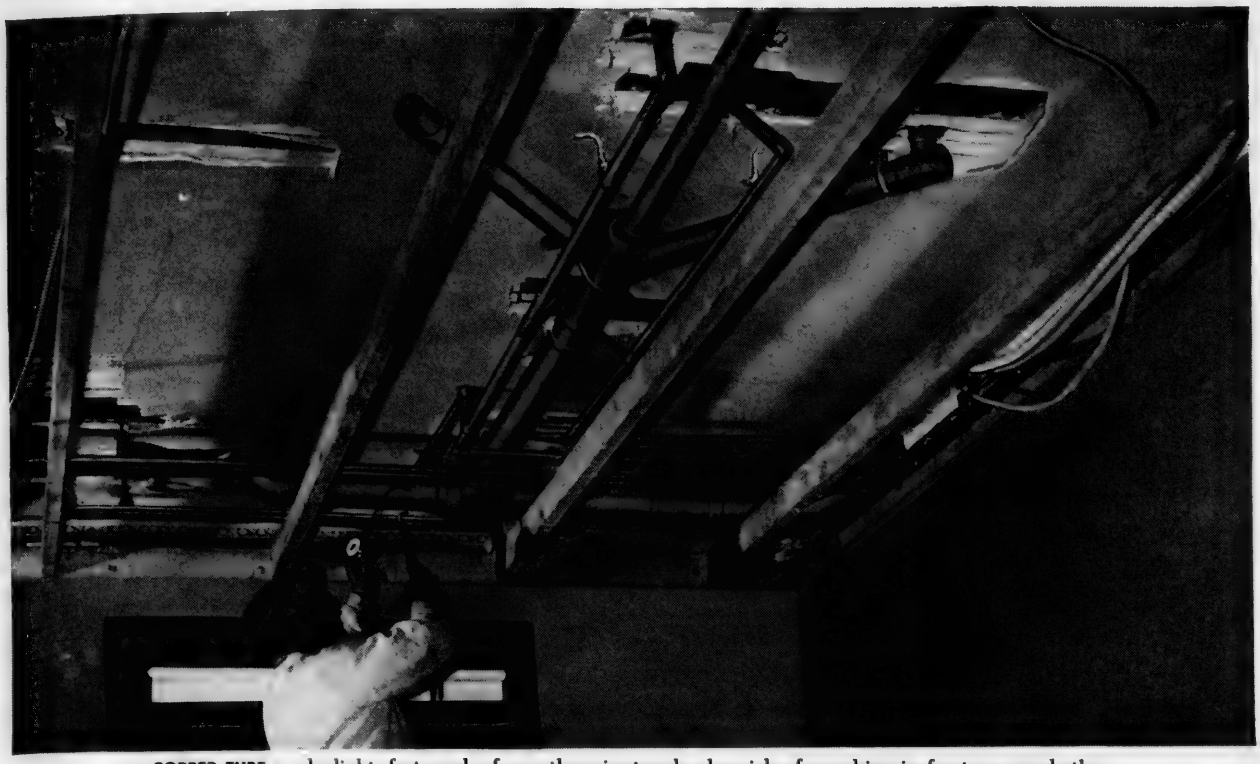
A. M. BYERS CO., Pittsburgh, Pa., announces the appointment of Robert J. Heister as manager of its Pittsburgh Division. He has been with the company since 1948, lately as field service engineer . . . TACO HEATERS, INCORPORATED, Cranston, R. I., has appointed Wallace E. Johnson manager of national accounts . . . Milt Larson, recently appointed an instructor in refrigeration and air conditioning for the Training and Education Dept., BELL & GOSSETT CO., Morton Grove, Ill., had organized and operated the Apprentice Training Program for the Chicago Refrigeration and Air Conditioning Contractors' Association . . . Responsibility for all manufacturing operations at COPELAND REFRIGERATION CORP., Sidney, Ohio, has been given to B. W. Moreland, named general manager. His 25 years in compressor manufacturing included ten with Carrier, five with Worthington, and seven with GE . . .

New sales manager for Genetron refrigerants and aerosol propellants produced by ALLIED CHEMICAL'S GENERAL CHEMICAL DIVISION is Fred C. Hitchings, succeeding Lee D. Callans who has been named manager of the Division's Market Surveys Department . . . Dr. J. F. Dunn is appointed assistant director of research for WALWORTH CO., New York, N. Y. Prior to joining the company in 1957, he was a project leader in the Dynamic Analysis and Control Lab at MIT . . .

Robert H. Chaffee has assumed the position of executive vice-president in charge of sales with WATTS REGULATOR CO., Lawrence, Mass. He has had a wide and intimate experience with promotion and sales of hot water heating specialties in the plumbing and heating industry.

ROY CARTER, public works consultant and manager of the Volute Pump Section, Worthington Corp., Harrison, N.J., died recently after a long illness. A native of Scranton, Pa., Mr. Carter joined the company in 1923 after having received a Master's degree from Columbia University. He was widely known as the author of many technical articles and is co-author of a current series on centrifugal pumps in this magazine.

ROBERT W. NELSON, vice-president of American Air Filter Co., Louisville, Ky., died suddenly on October 9 while at work. He was a past president of Air Moving and Conditioning Association and a member of the American Society of Heating and Air-Conditioning Engineers. In 1939 he joined Herman Nelson Corp., Moline, Ill., and was a vice-president when it merged with AAF in 1950.



COPPER TUBE made light, fast work of an otherwise tough, slow job of roughing-in for two new baths on the second floor of a large old single-family house which was renovated to make several apartments.

Go after profits in remodeling with time-saving, space-saving, money-saving COPPER TUBE

"I've seen lots of copper tube installed and know how easily it handles, but in this remodeling job, copper really proved its worth," says a plumbing contractor's superintendent.

"With copper tube and solder-joint fittings, the overhead work necessary was no problem. But think what a back-breaking, time-consuming operation this would have been using heavier materials requiring threaded or caulked connections. And note all the space we saved—thanks to trim copper tube and compact fittings.

"I wish every architect, builder, and plumbing contractor who is skeptical about the value of all-copper plumbing could have seen this job go in. And copper has the same advantages in new construction, too."

Whether you are adding a single bathroom or renovating the plumbing in an entire house, copper tube and fittings can make your work easier and more profitable. Contractors report their installation time with copper is reduced one third to one half.

Anaconda Copper Tubes are available in all standard wall thicknesses—Types K, L, M, and DWV (Copper Drainage Tube)—through your plumbing wholesaler. See him also for Anaconda wrought copper and cast-brass solder-joint fittings.

For more information on ALL-COPPER plumbing, write: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

8905

ROUGHING-IN for a bathroom on the third floor. Note small area of flooring removed—also that only small holes were needed in the old floor joists to install the copper tube waste line.

ANACONDA®

COPPER TUBES AND FITTINGS

Available Through Plumbing Wholesalers

Scientific Frontiers

Weather Research

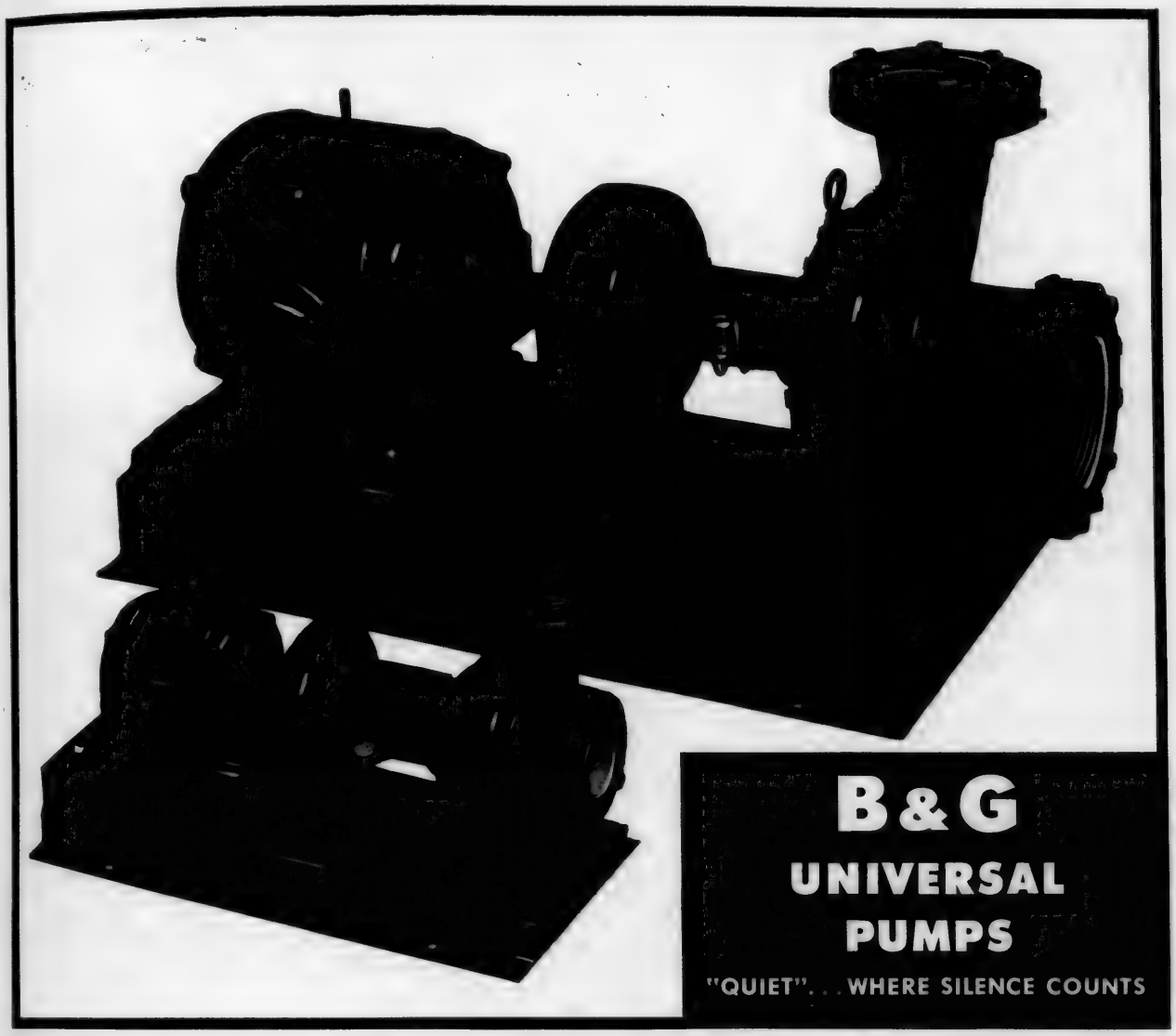
Formation of a National Institute of Atmospheric Research to co-ordinate studies of the world's vaguely understood atmosphere, for both defense purposes and the ultimate possibility that weather can be controlled, will be undertaken by twelve of the nation's leading universities. The project was announced by Dr. Henry G. Houghton, director of the Department of Meteorology of Massachusetts Institute of Technology. In stressing the theme of "weather is the nation's business", Dr. Houghton noted that research could result in information which could control disastrous floods; also, should it be found that weather can be managed, the nation's agriculture would benefit.

Some present thinking on the subject of controlling the climate is contained in an article, "Trends in Climatology", by H. E. Landsberg, published by the American Association for the Advancement of Science in a recent issue of *Science*, Mr. Landsberg states that the word *control* implies that you know what to do and when and where to do it. Further, some of the talk about control can be ascribed to misinterpretation of dimensions. Most of it glosses over the fact that for major climatic changes one would have to modify substantially the tremendous amount of solar energy received by the earth. The energy liberated from the total probable stores of fission and fusion bombs would not equal the energy of the average thunderstorm activity on earth over a few days' time. Albedo [ratio of energy reflected to that received] changes can presently be envisaged only on a relatively small scale. Ocean currents are hard to divert; mountains are difficult to move. And these remain the major terrestrial climatic controls.

Conceivably one could throw enough dust into the stratosphere by nuclear explosions to intercept an appreciable amount of solar radiation. This might, again conceivably, cause some changes of the general circulation. The effect would pass off in a few years — a short time as climate spans go. Also, the effect would be general over the globe, with unpredictable effects as far as small land segments are concerned. It could hardly be called control.

There is talk about trigger effects. This means that a small amount of energy can set off a larger, latent energy store. But where is the "loaded gun" in the atmosphere? The nearest analogy is the latent heat of the water vapor. If condensed in spots, it could add heat which could be transformed into other forms of energy. Temperatures might be raised, motions increased. Here, too, in spite of the sometimes advocated spreading of hygroscopic nuclei, little in the form of "control" can be foreseen in the near future.

The trigger effects, the albedo effects, even the direct addition and subtraction of energy, can now only be contemplated for local modifications of climate. The microclimate is readily manipulated and much along this line has been accomplished over the last few decades. This includes many of the horticultural practices from frost protection to shelter belts, from moisture-conserving mulching to irrigation. On a somewhat larger scale, creation of artificial lakes, changing of river courses, large-scale reforestation, and artificial suppression of evaporation have small but measurable climatic influences. Also along this line, slight local increases of orographic rainfall by cloud seeding have been made probable. Cloud modification, if systematically carried on, by coalescence of droplets or by their dissipation, is among the potential producers of local climatic effects. However, as far as obtaining climatic influences on a medium or large scale is concerned, a little more humility in the face of the overwhelming powers of nature seems to be indicated for the present.



B&G
UNIVERSAL
PUMPS
"QUIET"... WHERE SILENCE COUNTS

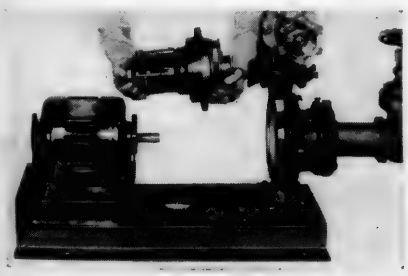
QUIET... FROM 1 TO 40 H.P.

With the line of B&G Universal Pumps now covering a range of from one to forty horsepower, every conceivable circulation requirement of systems using water for heating and cooling can be satisfied.

The B&G Universal Pump is an outstanding example of a product designed to meet a specific need. It is engineered and built to satisfy in every detail the exacting demands of circulated water systems, *Silent, vibrationless operation* is the keynote of the Universal's performance.

Motors are specially constructed and selected for *extra-quietness!* Long *sleeve* bearings are used in both motor and pump and the oversized shaft is made of special alloy steel with an integral, heat treated thrust collar. Water leakage is prevented by the exclusive diamond-hard "Remite" mechanical seal. Flanges, bolts, nuts and gaskets for both suction and discharge sides and pet cocks for venting and gauge tappings are furnished without extra charge.

Send for descriptive literature and engineering data.



Easy to service...vertical split case construction permits removal of entire bearing frame without disconnecting pipes.

Reg. U.S. Pat. Off.

BELL & GOSSETT
COMPANY
Dept. FM-4, Morton Grove, Illinois
Canadian Licensee: S.A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto 16, Ontario

MULTI-VENT®

low velocity air diffusers specified for the West's largest office building

Multi-Vent will handle the air distribution in over 70% of Kaiser Center's office building, the largest west of the Mississippi, scheduled for completion late in 1959.

Multi-Vent is the ideal air diffuser for office space because it need never be moved, or even adjusted when partitions are relocated. Distributing air at low velocities by gentle pressure displacement, Multi-Vent provides truly sightless, soundless, imperceptible air conditioning comfort, unmatched by any other diffuser.

Multi-Vent panels, adjustable valves and flexible duct connections are concealed in metal pan ceilings because standard perforated pans (with acoustic pads removed) serve as diffuser plates. Panels (with diffuser plate) install flush in plaster and fiber ceilings.

KAISER CENTER, Oakland, California

Architect: Welton Becket & Associates, San Francisco
Mechanical Engineer: Dudley, Deane & Associates, San Francisco
Mechanical Contractor: Scott Company, Oakland

Recent Multi-Vent Installations Coast to Coast

Banker's Trust, New York City
Baptist Tabernacle, Atlanta
Boeing Airplane Co., Seattle
Ford Motor Co., 21 Buildings
Graybar Electric, Illinois
Inland Steel Building, Chicago
National Bank of Detroit, Detroit
Parke Davis Bldg. 64, Detroit
Procter & Gamble Tech. Center, Cincinnati
Prudential Insurance Co., Newark
Travelers Insurance Co., Hartford

Write for detailed literature.

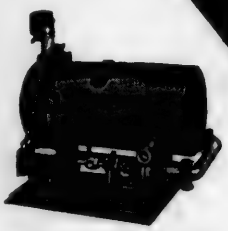
THE PYLE-NATIONAL COMPANY

MULTI-VENT DIVISION

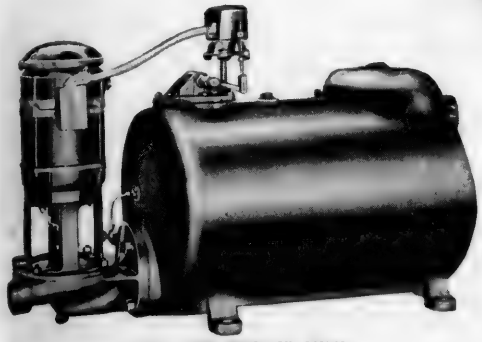
WHERE QUALITY IS TRADITIONAL

1374 N. Kostner Avenue, Chicago 51, Illinois

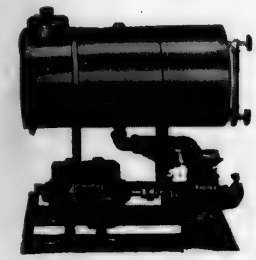
SALES AGENTS IN PRINCIPAL CITIES OF THE UNITED STATES AND CANADA



"HS" CONDENSATE PUMP



"VC" CONDENSATE PUMP



"TM" TURBINE PUMP

"UV"
CONDENSATE PUMP

TOM JOB

A standard type Skidmore Pump will meet the exacting requirements

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. . . to

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pe nce!

- **TYPE "HS"**

  Sturdily constructed for dependable service at small investment — capacities 1,000 to 65,000 sq. ft. E.D.R., discharge pressures from 10 to 75 lbs.

- **TYPE "VC"**

  Ideal for handling hot condensate, unit operates quietly, and is easily accessible for inspection — capacities 1,000 to 65,000 sq. ft. E.D.R., and discharge pressures from 10 to 75 lbs.

- **TYPE "TM"**

  Completely assembled on either steel or cast iron base—capacities, for boilers up to 250 H.P., with discharge pressures to 150 lbs.

- **TYPE "UV"**

  Designed for low return installations — capacities, 2,000 to 40,000 sq. ft. E.D.R. and discharge pressures from 10 to 75 lbs.

Write for bulletins of the Skidmore Pumps listed above.

DMORE
RATION
JOSEPH, MICH.

Choose with Confidence!

FICTION FACT

FICTION:

It costs less to buy replaceable filters and throw them away when dirty than to have permanent filters cleaned.

FACT:

R P Washable Industrial Filters can be cleaned 10 times annually for under $4.00 per year (including odor-removing adhesive and depreciation on filter).

RP

Multi-Velocity Industrial AIR FILTERS

R P Multi-Velocity Industrial Air Filters are designed with ease and economy of operation in mind. Their strong, rugged aluminum construction increases service life—makes them fast, easy and safe to handle—reduces operating costs. Important additional savings too, by eliminating the need for heavy structural design in filter bank construction.

These high efficiency, multi-velocity filters meet all specifications for permanent-type washable filters—with the plus feature of ODOR REMOVAL through the use of R P Super Filter Coat—the water soluble dirt *and odor* removing adhesive, with the "built-in" detergent. *Write for information.*

RP *Products of Research*

RESEARCH PRODUCTS *Corporation*

Dept. 47, Madison 10, Wisconsin

They compared "K" factors and cost factors . . . and bought ULTRALITE® Duct Insulation

FOR INFORMATION AND DELIVERY, CALL YOUR LOCAL ULTRALITE DISTRIBUTOR (LISTED IN THE YELLOW PAGES)

Compare and you'll find that ULTRALITE is the only glass fiber duct insulation (and duct liner) made exclusively of long, strong, textile-type glass fibers. This means that ULTRALITE is stronger and more resilient than the rest . . . that it is more resistant to damage from vibration, air movement, and handling . . . that it offers more uniform thickness that results in full insulating efficiency and a neater job. *Compare* . . . and you will also find that ULTRALITE is outstanding in thermal efficiency and ease of application.

You pay not a penny more for ULTRALITE'S many advantages. You'll find it readily available in all major cities from local distributor stocks, plain or with a variety of factory-adhered facings that enhance appearance and prevent moisture condensation.

GUSTIN-BACON *Manufacturing Co* GUSTIN gb BACON

222 W. 10th St., Kansas City, Mo.

Thermal and acoustical glass fiber insulations • Pipe couplings and fittings
Molded glass fiber pipe insulation

NEW YORK'S COLISEUM USES ALLEN-BRADLEY TROUBLE FREE MOTOR CONTROL

A-B QUALITY

Owner: Triborough Bridge and Tunnel Authority
Heating, Ventilating, and Air Conditioning Contractor: Almirall & Co., Inc.
Engineer: Guy B. Panero
Architects: Leon & Lionel Levy

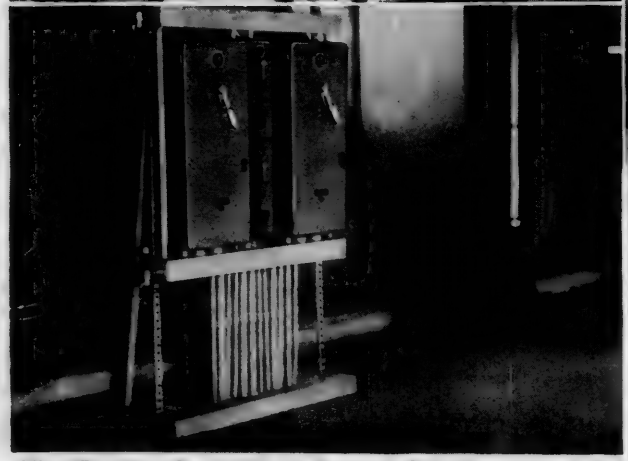
More and more buildings—like the huge New York Coliseum—are being equipped with Allen-Bradley quality motor control.

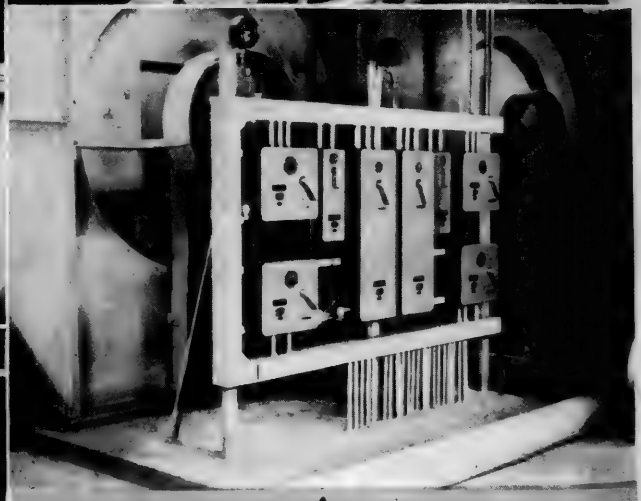
Reliability is the basis for their selection. Allen-Bradley solenoid starters have only *ONE* moving part—this is your assurance of *millions* of trouble free operations. Also, all Allen-Bradley controls use double break, silver alloy contacts that never need servicing. The overload relays dependably protect the motor—no matter how long in service.

Specify Allen-Bradley—the motor control you can install . . . and forget!

Bulletin 740 reduced voltage and Bulletin 712 combination starters for chilled water and condenser pumps. ▶

Bulletin 712 combination starters for booster and condenser water pumps. ▼



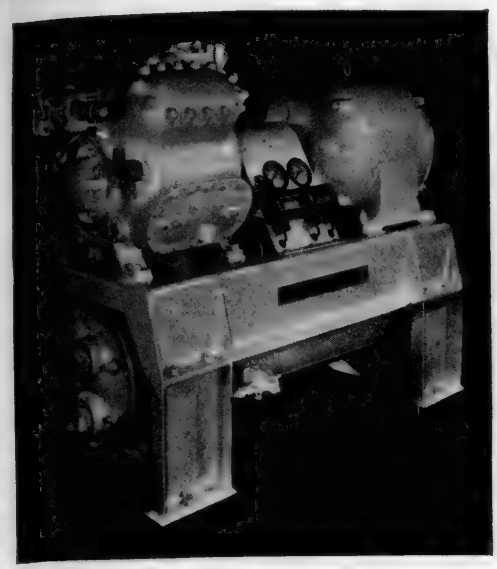


◀ Bulletin 712 combination starters, Size 1 and Size 4, mounted in fan room.

▲ This fan room control panel uses eight Bulletin 712 combination starters—including Sizes 1, 2, and 3.

ALLEN-BRADLEY
MOTOR CONTROL
QUALITY

Allen-Bradley Co., 1330 S. Second St., Milwaukee 4, Wisconsin • In Canada: Allen-Bradley Canada Ltd., Galt, Ont.



ANOTHER B&G REFRIGERATION "PACKAGE"

...WITH ALL MAJOR COMPONENTS BUILT AND GUARANTEED BY BELL & GOSSETT COMPANY

B&G CONDENSING UNIT

An achievement in compact efficiency, featuring interchangeable vital parts. 7½ through 150 tons.

The B&G Condensing Unit offers an impressive list of features, *many of them exclusive*, which make it completely outstanding. It is amazingly compact as well as efficient—the shortest unit available on the market today.

The cut-away illustration shows the highlights of compressor construction—

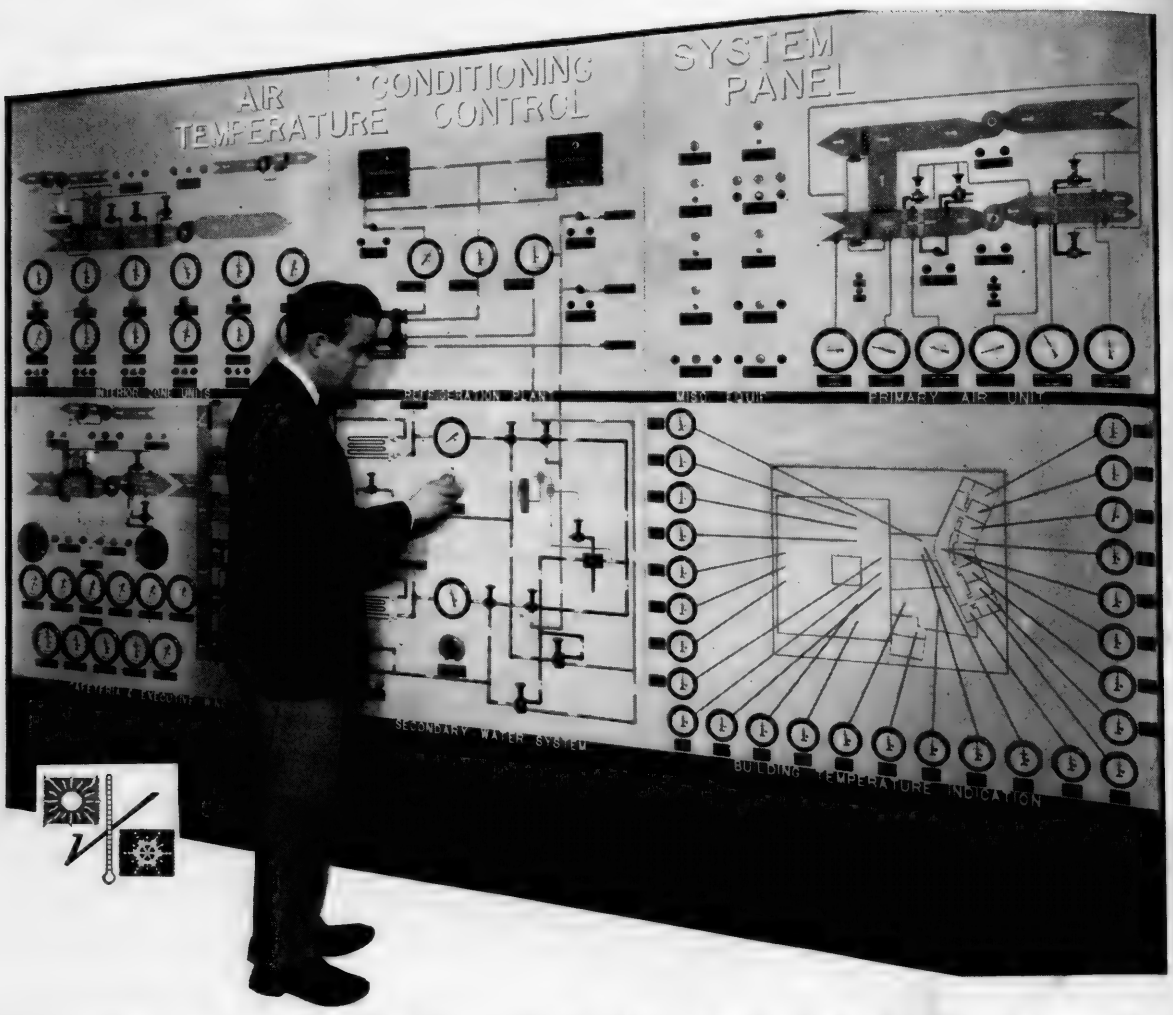
1. **Compressor housing.** Monobloc design using pressure-tight iron which meets Underwriters' requirements for use with R-12 or R-22.
2. **Cylinder heads and cover plates.** Cast of same material as compressor housing.
3. **Suction and discharge valves.** Highest grade Swedish steel—non-flexing, full floating. Low lift with positive gas-cushioned backstop for quiet operation.
4. **Safety springs.** Prevent damage from occasional liquid slugs.
5. **Pistons.** Automotive type, of light weight alloy. Full floating wrist pin, two compression rings and one oil control ring.
6. **Connecting rods.** Light weight, heat-treated alloy—rifle drilled to assure positive lubrication of wrist pin.
7. **Cylinder sleeves.** Removable cylinder liners of special alloy iron are machined and housed to a maximum tolerance of 0.0005 inches.
8. **Crankshaft.** High tensile, ductile iron. Greater strength and noise dampening qualities make it superior to conventional forged steel shafts. Running surfaces induction hardened and polished—shafts are statically and dynamically balanced—rifle drilled for forced feed lubrication.
9. **Main bearings.** Heavy wall bronze, diamond bored after assembly for close tolerance.
10. **Forced feed lubrication.** Positive-displacement, self-reversing oil pump supplies excessive oil to main bearings, connecting rods and wrist pins.
11. **Crank case heater.** Standard equipment on all compressors.
12. **Capacity Control.** Can be equipped with multi-step capacity control system.
13. **Standard equipment.** Gas and oil equalization ports, magnetic plugs and oil sight glass.

Cut-away Compressor of Condensing Unit

BELL & GOSSETT
COMPANY
Dept. RFM-4, Morton Grove, Illinois

Reg. U.S. Pat. Off.

Canadian Licensee: S. A. Armstrong Ltd., 1400 O'Connor Drive, Toronto 16, Canada



Johnson Control Centers Set the Pace in Comfort, Simplify Air Conditioning Operations

A highlight of Guarantee Mutual Life Company's new home office in Omaha, acclaimed one of the nation's most modern buildings, is this air conditioning Control Center by Johnson.

The Center allows the engineer to supervise and operate all 10 air conditioning systems right from his office! Guiding him is a *continuous* visual display of vital data that shows at a glance the exact operating status of each system and gives him an instant check of building temperatures at strategic control points. To adjust key temperatures, he merely turns a dial! Other functions are equally easy and efficient.

The advantages of the Johnson Control Center are impressive. It simplifies an otherwise complex job, cuts fuel and power consumption, prolongs equipment life. It saves an untold amount of time. And it assures a consistently ideal working climate for Guarantee Mutual's employees.

Johnson Control Centers are now bringing similar benefits to buildings of all types and sizes. A nearby Johnson engineer will gladly supply you with complete information. Johnson Service Company, Milwaukee 1, Wisconsin. 105 Direct Branch Offices.

Guarantee Mutual Life Company, Omaha, Nebraska. Leo A. Daly Co., architects-engineers; Peter Kiewit Sons Co., general contractor; Natkin & Company, mechanical contractor; all of Omaha.

JOHNSON CONTROL

PNEUMATIC SYSTEMS

DESIGN • MANUFACTURE • INSTALLATION • SINCE 1885

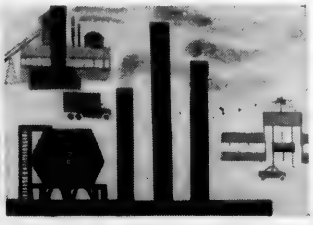
TEMPERATURE CONTROL SYSTEMS FOR SCHOOLS, OFFICES, FACTORIES, STORES, HOSPITALS, HOTELS, PUBLIC BUILDINGS

WORTHINGTON

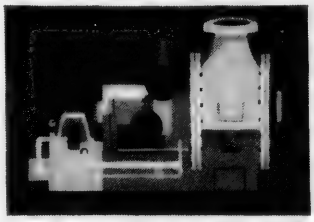
This is our new corporate face... a new symbol of our classic Worthington "wings." This new mark is much easier to see and attracts more attention. But it still represents the qualities and values which have made Worthington and Worthington products outstanding in performance, reliable in operation, trusted in every market place in the world.

This mark is by no means the only change at Worthington. There are many new air conditioning and refrigeration products and developments coming. You can expect brand-new improvements...brand-new, yet backed by the skills and experience of a leader in the air conditioning industry. These products will make news and they will be copied. We know that and expect it. It is part of the record of leadership that has been associated with Worthington for over 118 years. Worthington Corporation, Air Conditioning and Refrigeration Division, Harrison, N. J. In Canada: Worthington (Canada) Ltd., Brantford, Ontario.

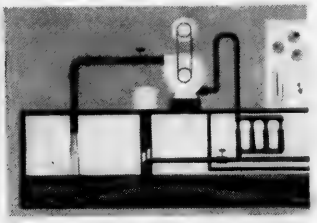
NEW sales organization...serves both direct and distributor sales, is geared to customer needs.



NEW decentralized divisions feature integral application, manufacturing and engineering units.



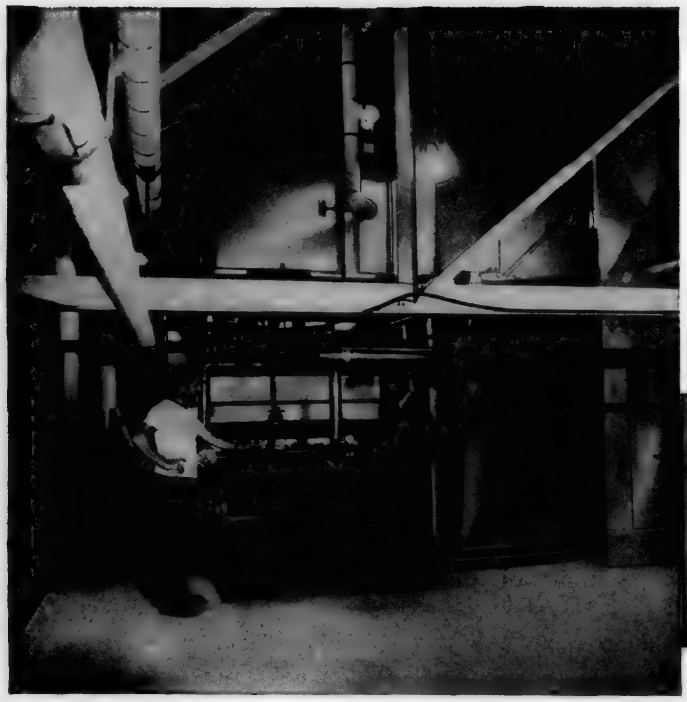
NEW products and lines . . . include many additions to broad lines of power service equipment.

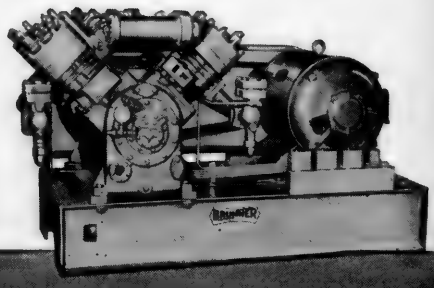


NEW emphasis on research . . . 10 laboratories keep Worthington in leading product-market position.

FOR THOSE BIG AIR CONDITIONING JOBS...

Compressors from the BIG BRUNNER SINCE 1906 LINE





LONG LIFE, RELIABLE OPERATION FEATURES OF BRUNNER COMPRESSORS INCLUDE:

- MOUNTING BASES CONSTRUCTED OF STRUCTURAL STEEL
- LOW AND HIGH PRESSURE TYPE CONTROL
- FORCE FEED LUBRICATION
- PRESSURE RELIEF SAFETY VALVE
- UNLOADER AND UNLOADED START (optional)

Typical of the BIG air conditioning jobs where architects, consulting engineers and contractors have learned to rely on BRUNNER compressors is the new Bostitch plant in East Greenwich, Rhode Island.

75 HP compressors, 100 HP compressors—whatever the size requirement—there was a Brunner unit to satisfy the design conditions.

Rugged workhorses of the various air conditioning systems at Bostitch, these units are tied-in to Dunham-Bush evaporative condensers and serve ceiling mounted air handling units for the Stapling, Engineering and Drafting departments. They also serve Dunham-Bush multizone units for conditioning executive offices and cafeteria areas.

Select Dunham-Bush and Brunner for *single source service and responsibility.*

BRUNNER DIVISION

DUNHAM-BUSH, INC.

WEST HARTFORD, CONN.

DUNHAM-BUSH

AIR CONDITIONING • REFRIGERATION • HEATING • HEAT TRANSFER

WEST HARTFORD, CONNECTICUT • MICHIGAN CITY, INDIANA • MARSHALLTOWN, IOWA

RIVERSIDE, CALIFORNIA • BRUNNER DIVISION, UTICA, NEW YORK

SUBSIDIARIES

heat-x HEAT-X, INC. BREWSTER, N.Y. · BRUNNER THE BRUNNER CO. GAINESVILLE, GA. · DUNHAM-BUSH (CANADA) LTD. TORONTO, CANADA

DUNHAM-BUSH LTD. LONDON, ENGLAND · BRUNNER BRUNNER CORPORATION (CANADA) LTD. PORT HOPE, ONTARIO

even the bearings are built for "comfort" in Fafnir-equipped Westinghouse Comfort Command Air Conditioners

When Westinghouse designed the versatile Comfort Command Air Conditioner, they built it for cool, quiet, trouble-free comfort right down to the blower wheel bearings! ✓ ✓ ✓ Fafnir Super-Quiet Ball Bearings on the blower shaft feature balls and races specially polished for noiseless service. Fafnir-developed current-conducting rubber grommets absorb vibrations ...eliminate the need for grounding clips or springs. ✓ ✓ ✓ Bearing maintenance is practically nil. Relubrication is never needed. Plya-Seals, contact type, lock in factory-packed lubricant, and protect against contaminants. ✓ ✓ ✓ Investigate Fafnir's wide selection of ball bearings and ball bearing units for heating and air conditioning equipment. Chances are, you'll find types and sizes that fit your needs precisely. Write for bulletin today to The Fafnir Bearing Company, New Britain, Connecticut.

FAFNIR SUPER-QUIET BALL BEARINGS on blower shaft assure silent, power-saving, maintenance-free service. Available with or without rubber grommets, and in rubber cartridges or pressed steel, rubber interlined pillow blocks.

WESTINGHOUSE COMFORT COMMAND offers customized home cooling. Combines with any hot air system for year-round, automatically-controlled indoor comfort. Economical air-cooled condensing unit (illustrated) permits outdoor installation, with add-on cooling coil unit for interior duct installation.

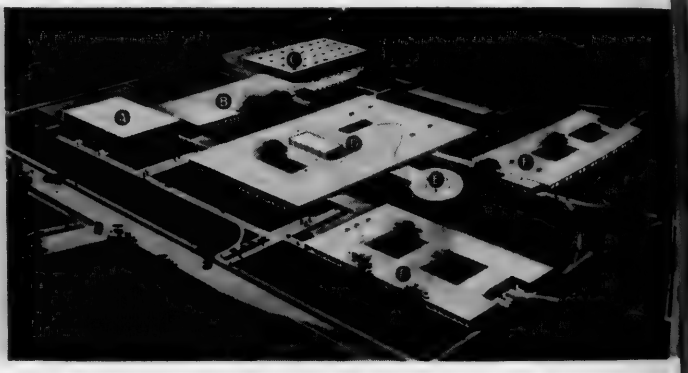
Heating and year-round air conditioning in ne

Air conditioned Library, round Building E, shown below.

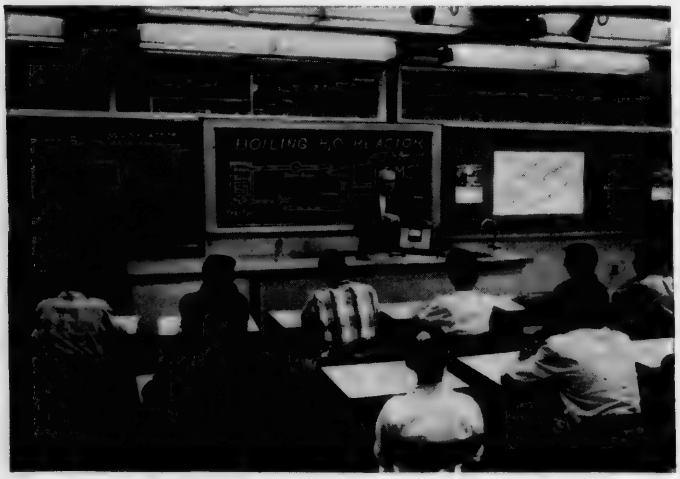
Linton Comprehensive High School
SCHENECTADY, N. Y.

Building A, is air conditioned Auditorium with choral, band and orchestra rooms; B) Cafeteria and multipurpose area; C) Gymnasiums, 3 large, 2 small; D) Core-Tech building with shops, also air conditioned administrative offices, Science, Arts, Family Living and Commerce departments; E) Air Conditioned Library; F) Academic classrooms.

Planned enrollment: 1800. Grades housed: 10th, 11th and 12th. Area 258,157 sq. ft. Construction Cost: $4,328,130.



Schenectady (home of General Electric Co. a pioneer in nuclear power plants) is justly proud of LINTON'S excellent science department. (63)



new LINTON HIGH SCHOOL regulated by

POWERS

Pneumatic system of Temperature Control

"Plan a School that will still be functional in the year 2000"

. . . that was the challenge faced by the educational, architectural and engineering planners of Schenectady's much discussed Linton High School. One of the important innovations here is the year-round air conditioning in the Core-Tech building D, shown on opposite page, also the Auditiorium A, and the round Library building E.

Proper thermal environment is a valuable aid to effective teaching and learning. The flexibility of the Powers temperature control system installed at LINTON meets the demands of varied types of activity and occupancy in all seven buildings.

Air Conditioning, heating and ventilating systems are regulated from Powers Control Center located in the boiler room. See photo below at right.

Day control for the air conditioning systems during the cooling season consists of dew point control for the chilled water coils with individual reheat mixing damper control for each zone controlled from a zone thermostat.

Night control of the air conditioning systems provides reduced room temperatures during the summer "night" cycle when the buildings are unoccupied, with a minimum of refrigeration. This feature is designed to provide precooling and reduced start-up load.

A Powers MASTROL System controls the hot water heating system plus individual room control of convectors in critical areas.

In the Year 2000, the Powers temperature control system at Linton will likely still be functional. Twenty-five to 50 years of dependable operation with a minimum of maintenance is often reported by users of Powers control.

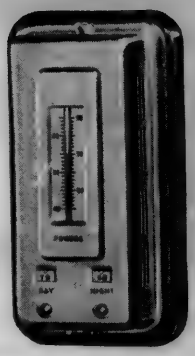
In Your New School make sure taxpayers get the biggest return on their investment in accurate temperature control. Ask your architect or engineer to include a time-proven Powers Quality System of Control.

Architects: PERKINS & WILL
Chicago and White Plains, N. Y.

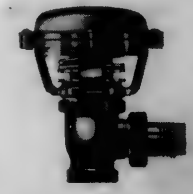
Associate Architects: RYDER & LINK
Schenectady, N. Y.

Mechanical Engineer:
E. R. GRITSCHKE & ASSOC., INC.
Chicago, Ill.

Heating and Air Cond. Contractor:
TOUGHER HEATING & PLBG. CO.
Albany, N. Y.



190 Powers DAY-NIGHT Thermostats here help prevent OVERheating in occupied rooms and are adjustable for lower economical temperatures during unoccupied periods.

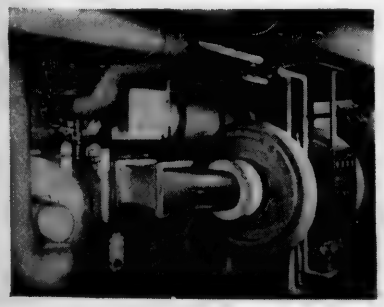


216 Powers PACKLESS Control Valves are used on convectors and unit ventilators. They're labor savers, banish packing maintenance and will prevent damage from water leakage.

THE POWERS REGULATOR COMPANY

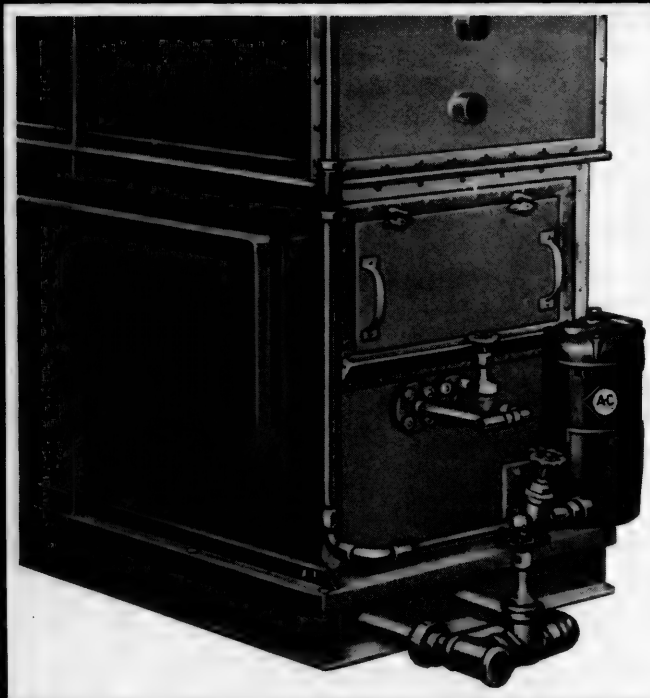
SKOKIE, ILL. | *Offices in chief cities in U.S.A. and Canada*

65 YEARS OF AUTOMATIC TEMPERATURE AND HUMIDITY CONTROL



Left: 235 Ton Centrifugal refrigeration compressor has ample capacity for building D and library, or auditorium alone when other two buildings are not in use.

Right: Powers Control Center in boiler room. Center photo: one of 5 air conditioning systems and 9 of 68 Powers Sub-Master Thermostats controlling conditioned air to various spaces.

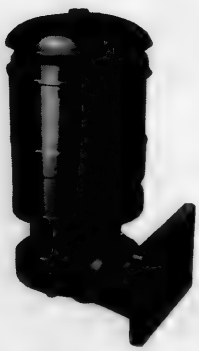


Plan to stay ahead... MODERNIZE!

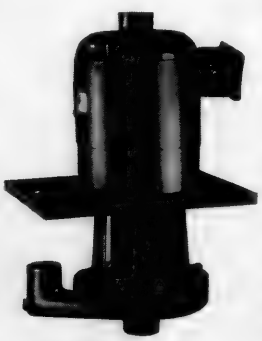
Vertical air washer
uses A-C flange-mounted pump directly mounted on washer reservoir.

A choice of pumps

for air-conditioning equipment—sealless or with mechanical seal...



Only 5-inch submergence
is needed by submerged-mounted models. They are sealless for season-after-season reliability.



Four optional positions
for the motor are possible with this sidewall-mounted model. It is also sealless to minimize maintenance.

HERE'S a line of air-conditioning pumps from Allis-Chalmers engineered with one idea: *to make equipment designers' jobs easier*. Here's how A-C did just that:

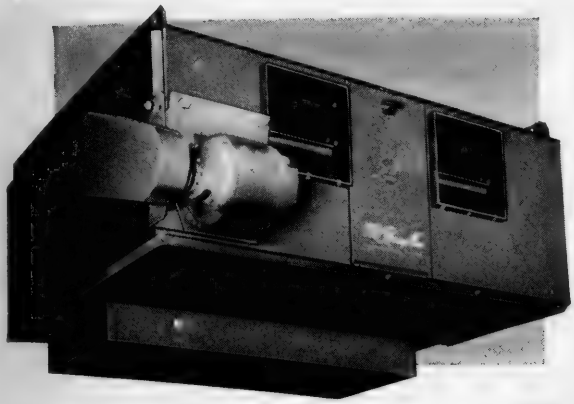
- **Choice of mounting** — Complete line permits *six* different mounting methods . . . for design flexibility of all types of systems.
- **Less tank room required** — Submerged models need only *5-inch* submergence. You save on tank size.
- **Choice of impeller** — Single-suction impellers are available in either enclosed or open design.

IN ADDITION to submerged and sidewall-mounted units, Allis-Chalmers also offers close-coupled and horizontal pumps to meet 99% of all air-conditioning applications.

A-C PUMP EXPERTS can help with your application. Contact your Allis-Chalmers representative or distributor, or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

A-5700



McQuay "HC" Horizontal heating and ventilating unit. Available in three coil types, standard steam, jet tube steam and hot water.

Flexible for any job
Versatile for any need

THE McQuay LINE OF

HEATING and VENTILATING UNITS

McQuay "HC" heating and ventilating units are the most flexible and versatile available for a wide range of applications, such as schools, churches, hospitals, industrial plants, public and office buildings, and other large area installations requiring quiet, high volume heating and ventilating. They'll handle even the most difficult jobs with ease. Often one McQuay unit will do what normally would require two or more other units. And with McQuay "HC" units come the exclusive Ripple Fin coils and Dura-Frame construction essential to peak performance and economy and quiet, trouble-free operation for years to come. When you have a heating and ventilating problem, call in the McQuay representative or write McQuay, Inc., 1619 Broadway Street N. E., Minneapolis 13, Minnesota.

McQuay "HC" Vertical heating and ventilating unit. Also available in three coil types. A full line of accessories is available for all models.

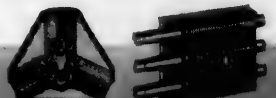
4 types
19 sizes

1,280 to 48,300 cfm.
26,200 to 2,931,500 Btu./hr.

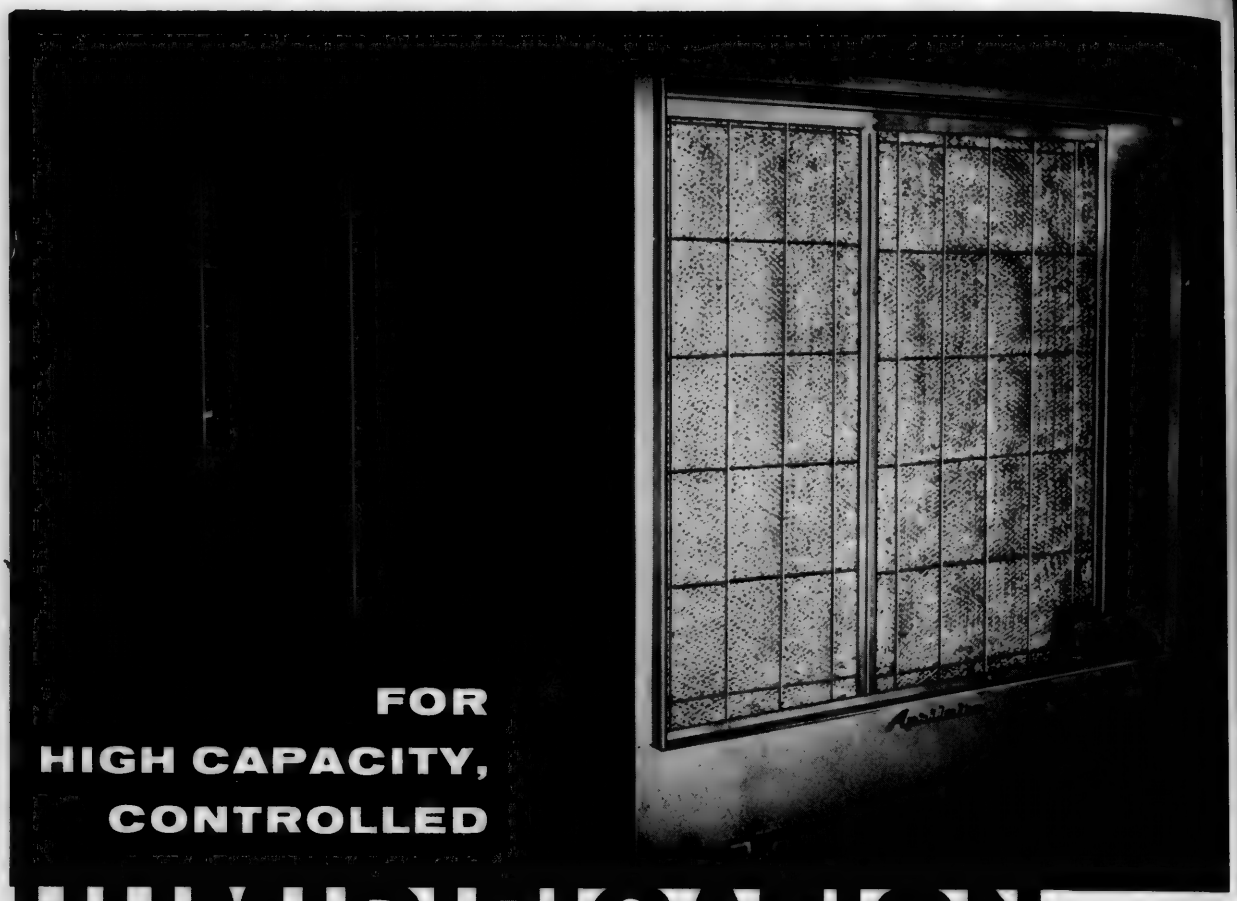
McQuay INC.

AIR CONDITIONING • HEATING • REFRIGERATION

IV leans Quality



McQuay units feature the exclusive Ripple Fin coils which create maximum air turbulence and have wide, full fin collars that act as automatic spacers to form a tube around the coil tube for greatest heat transfer and protection. The Dura-Frame "V" channel construction provides the strength and rigidity necessary for quiet, trouble-free operation.



FOR
HIGH CAPACITY,
CONTROLLED

HUMIDIFICATION

RP **Aprilaire**

AUTOMATIC-ELECTRIC HUMIDIFIERS

HIGH CAPACITY

Aprilaire Industrial Humidifiers (illustrated) are designed to provide capacity for practically any size requirements. Unit sizes up to 10 G.P.H.—can be installed singly or in a series of any number of units.

POSITIVE CONTROL

The Aprilaire introduces relative humidity as needed . . . and only when needed. Automatic control eliminates possibility of lag or over-run.

FLEXIBILITY

Aprilaire industrial models are easily installed packaged units. Available for gas, steam or hot water source, every model can be pedestal-mounted or suspended—according to individual requirements.

BACTERIA REMOVAL

Super-clean air, carrying moisture in vapor form only, is delivered by the Aprilaire's unique principle, incorporating the use of air filters and mineral coated evaporating elements. This exclusive humidification method removes up to 70% of the bacteria in the air stream circulating through the unit.

ISOTHERMAL OPERATION

The Industrial Aprilaire has no temperature effect on the humidified air. Exhausted, humidified air is discharged at the same temperature it enters the unit.

MINIMUM MAINTENANCE

Because the only liming or water solids deposits occur on the inexpensive, replaceable evaporating elements . . . mechanical difficulties from these usually troublesome deposits are eliminated.

INDUSTRIAL AND RESIDENTIAL MODELS AVAILABLE—WRITE FOR COMPLETE INFORMATION

see our catalog in PLANT ENGINEERING FILE — or write for copy

RP . . . PRODUCTS OF RESEARCH

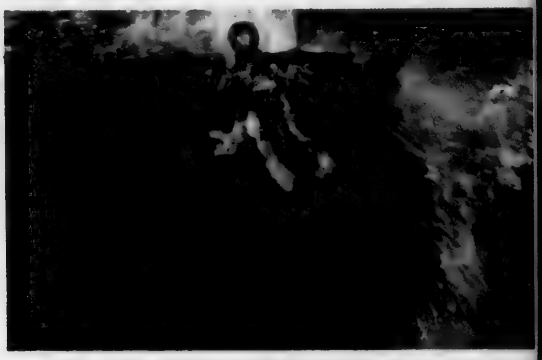
RESEARCH PRODUCTS *Corporation*

Dept. 913, Madison 10, Wisconsin

YOU GET
DOUBLE PROTECTION
against corrosion...
against falling
or splashing liquids

Air intakes and outlets are positioned to provide complete dripproof protection.

TYPE DP
1 to 125 hp



DOUBLY PROTECTED—Wagner DP Motors offer the *double protection* of completely dripproof enclosures and rugged cast iron frames that can take rough handling and resist corrosion.

with WAGNER TYPE DP MOTORS designed to meet more application needs

Wagner Type DP Motors offer the *double protection* of rugged corrosion-resistant cast iron frames and dripproof enclosures so well designed that the DP Motor can handle many applications that formerly required splashproof motors.

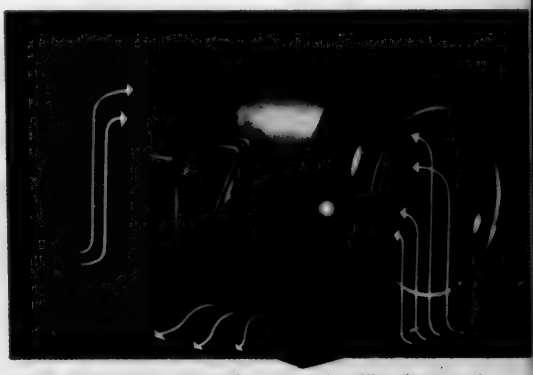
These Wagner Motors are built in the new NEMA ratings that pack more power in less space, are lighter in weight and are easier to maintain.

CAN BE RELUBRICATED—Factory lubrication will last for many years in normal service—but openings are provided to permit the relubrication that adds years to motor life under severe conditions.

SLEEVE BEARING MODELS AVAILABLE

The entire line of ratings through 125 hp is available with ball bearing construction as illustrated, or with steel-backed, babbitt lined sleeve bearings that have high load carrying capacity and provide quieter operation.

Let a Wagner Sales Engineer show you how these motors can be applied to your needs. Call the nearest branch office or write for Wagner Bulletin MU-223.



COOL RUNNING—Specially designed baffles direct cooling air through the motor to reduce stator temperature—thus increasing motor life. Blowers, cast as part of the rotor, move large volumes of air without noise or vibration.

1 to 125 HP—1750 RPM—40°C
NEMA FRAMES 182 through 445U

Wagner Electric Corporation
6400 Plymouth Ave., St. Louis 14, Missouri.

YOU GET
EXTRA PROTECTION
against corrosive... abrasive or explosive elements

TYPE JP
Explosion proof
1 to 100 hp

TYPE EP
Standard TEFC
1 to 100 hp

with Wagner totally enclosed motors... protected for longer motor life

If you need motors that will keep production rates up... that will give the continuity of service that is so important to automation... that will operate with complete dependability under the most severe conditions —Wagner totally-enclosed motors are your soundest choice.

Type EP Motors offer protection against corrosion, dust, abrasives, fumes, steel chips or filings. Type JP is explosion proof as well — designed and approved for use in explosive atmospheres.

NEW NEMA FRAMES—These motors are built in the new NEMA Frame sizes from 182 through 445U, with ribs that add mechanical strength and increase the surface cooling area. Effective cooling system adds to motor life.

Let your Wagner Sales Engineer show you how these protected motors can bring you savings on initial motor costs, maintenance costs and continuity of operation.

1 TO 100 HORSEPOWER—4 POLE, 60 CYCLE—NEMA FRAMES 182 THROUGH 445U

Wagner Electric Corporation

6400 Plymouth Ave., St. Louis 14, Missouri. Branches and Distributors in All Principal Cities

HEAVY DUTY BALL BEARINGS

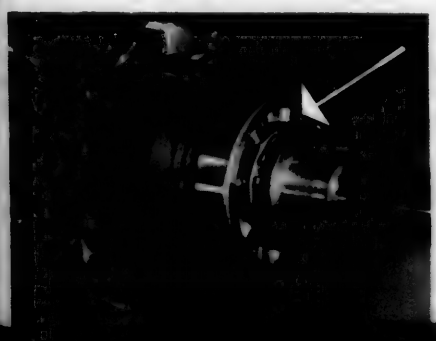
The ball bearings used in these motors are of the highest quality, with more than ample capacity to provide long troublefree service under heavy loads.

BEARINGS CAN BE RELUBRICATED

Factory lubrication will last for many years under normal service, but openings are provided to permit relubrication that adds years to motor life under severe conditions.

SEALS KEEP BEARINGS CLEAN

Both ends of these motors have running shaft seals to keep the bearings clean. Bearing housings are effectively sealed to prevent escape of grease.



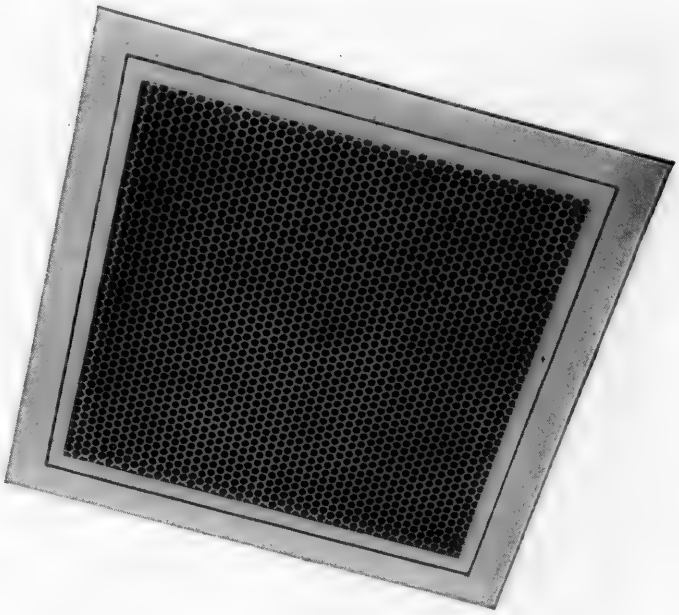
From our research and product development laboratory

AGITAIR®

Perfair

SQUARE AND RECTANGULAR

PERFORATED AIR OUTLETS



WITH THESE PRACTICAL PERFORMANCE FEATURES

- Provide Uniform Ceiling Design
- Can Be Located Anywhere In Ceiling
- Interchangeable Diffusing Cores
- Unlimited Patterns
- Built-In Air Controllers
- Adjustable for 1-2-3-4 Way Blows
- No Blank-Offs Required
- Maximum Turbulence — Aspiration
- Quick Temperature Equalization
- Uniform — Draftless Air Distribution

THE ULTIMATE IN APPEARANCE AND VERSATILITY

AGITAIR PERFAIR air diffusers incorporate all the essential features to meet the architects and engineers requirements.

The architectural styling of PERFAIR, both supply and matching return units, conform to all interior designs. The interchangeable core feature and built-in air controllers permit the location of PERFAIR units in any part of the ceiling as desired by the architects.

Engineers can depend upon AGITAIR PERFAIR air diffusers to meet their every requirement — maximum turbulence...aspiration...quick temperature equalization . . . uniform air distribution ...noiseless...draftless operation.'

For quick and easy installation of PERFAIR units, separate mounting frames are available for surface and tile applications.

Ask your AGITAIR representative for catalog P-200 or write direct to Air Devices Inc.

THERMOTANK AGITAIR

high velocity units • punkah louvers
air diffusers • filters • exhausters
registers and grilles

Sold exclusively by representatives for:

AIR DEVICES INC.

185 MADISON AVENUE, NEW YORK 16, N. Y.

It's the Showcase of the Industry!

SEE THE NEWEST IN PRODUCTS LIKE THESE AT THE EXPOSITION

Air-conditioning units and systems, boilers, burners, fans, blowers, bearings, condensers, compressors, controls, coolers, fittings, filters, engines, exhausters, heat exchangers, eliminators, dehumidifiers, diffusers, couplings, pipe cutters, drills, pumps, preheaters, motors, meters, piping, valves, hose, furnaces, heaters, grilles, hangers, gages, flanges, ventilators, washers, water treatment, tubing, traps, cooling towers, thermostats, thermometers, tanks, switches, finned surfaces, separators, regulators, refrigerants, radiators, recorders, coils, baseboard radiation, humidifiers, transformers, ducts, insulation, evaporators, registers, after coolers, circulators, controllers, cooling equipment, dampers, strainers, connection heaters, etc.

the 14th International Heating & Air-Conditioning Exposition

Under the auspices of the
American Society of Heating & Air-Conditioning Engineers
and in conjunction with their Annual Meeting.

Convention Hall
Philadelphia
January 26-29, 1959

Here under one roof you'll see and compare the newest products . . . talk to the informed representatives of 450 leading manufacturers . . . spot future trends . . . and be better prepared to meet tomorrow's problems.

This is a concentrated course in the latest developments arranged *for* men in the business *by* men in the business. You'll hear and see fresh ideas, channeled especially to you and your business. You'll find the Show an important place to gain new insight into both your job and your industry.

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MANAGEMENT: INTERNATIONAL EXPOSITION COMPANY

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Fill in and mail the coupon for advance registration and hotel information.

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Name_____ **Title**_____

Name_____ **Title**_____

Company_____

Street_____

City_____ **Zone**_____ **State**_____

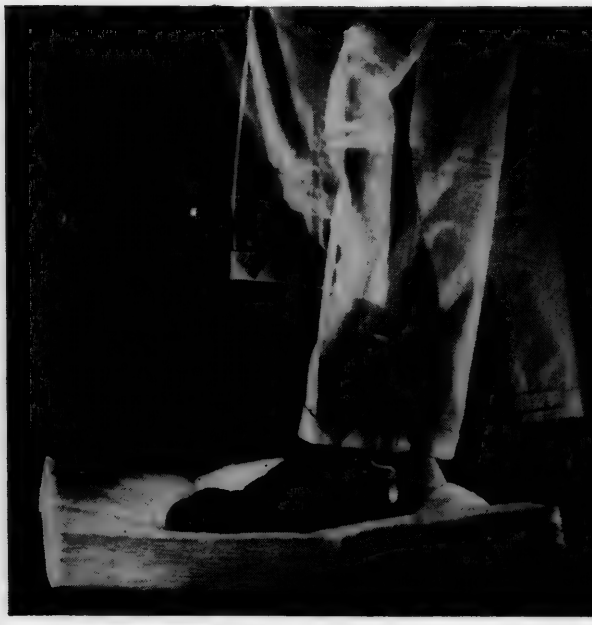
Products Made Or Type of Business_____

☐ **Check here if application form for hotel reservation is required.** 1260

Try these 3 tests with Pittsburgh Superfine Fiber Glass Insulation

PULL IT—see how strong Pittsburgh Superfine is! It's built to last wherever you install it. It retains this same strength indefinitely. Won't disintegrate or rot with age.

PRESS IT—and see how it returns to its original shape. You can compress Pittsburgh Superfine for long periods of time, yet it will always spring back to its former shape!



PITTSBURGH SUPERFINE FIBER GLASS is great for insulating against heat or cold or noise. It's lightweight, cuts easily to correct size . . . is rot-proof, fire-resistant . . . handles easily, avoids skin irritation . . . saves installation time. Try it!

For complete information on Pittsburgh Superfine, call your nearest PPG Sales Office, or write to *Pittsburgh Plate Glass Company, Fiber Glass Division, One Gateway Center, Pittsburgh 22, Penna.*

GIVE IT A BEATING—and see how Pittsburgh Superfine absorbs the shock, and comes back. Pittsburgh Superfine loves rough handling.

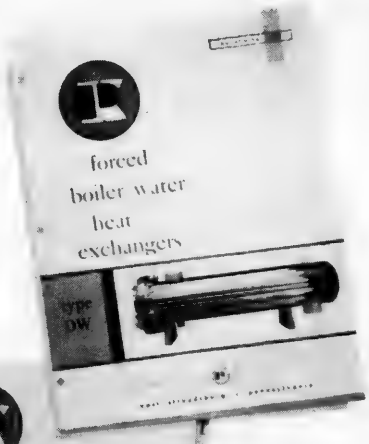
PITTSBURGH SUPERFINE INSULATION IS A PRODUCT OF THE FIBER GLASS DIVISION OF PITTSBURGH PLATE GLASS COMPANY

Sales Offices are located in the following cities: Charlotte, Chicago, Cincinnati, Cleveland, Detroit, Houston, Los Angeles, Minneapolis, New York, Philadelphia, Pittsburgh and St Louis

75th ANNIVERSARY 1883—1958 PPG

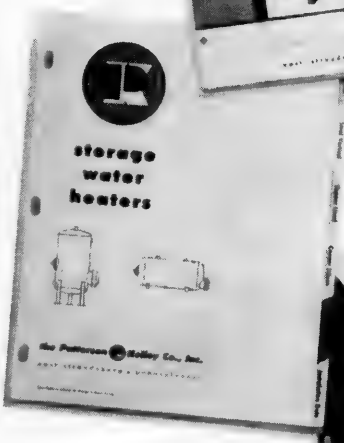
SYMBOL OF SERVICE FOR SEVENTY-FIVE YEARS

PITTSBURGH PLATE GLASS COMPANY

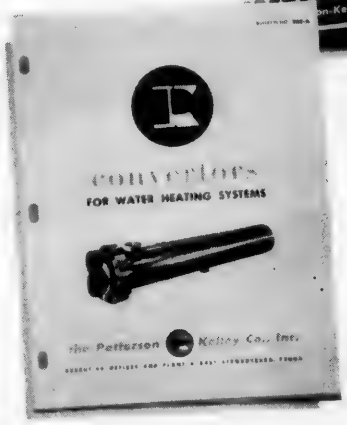


In Bulletin No. 6050 on P-K forced boiler water heat exchangers complete capacity tables are provided, grouped by temperature ranges. Pressure drop is shown for each capacity. Dimensional data supplied

Catalog No 19 covers P-K storage water heaters in plain steel, copper-lined, copper silicon, Pre-Krete lined, clad and galvanized. In addition to tabular data on capacities, weight and dimensions, this book carries a handy conversion table to determine capacities of heating sections with various temperature ranges and steam pressures.



Catalog No. 202 describes P-K instantaneous water heaters. Contains capacity tables covering two, four and six pass design. Tables are grouped by steam pressures ranging from 0 to 100 psi. Inlet and outlet temperatures are listed with hot water capacities.



In this P-K Bulletin No. 303-A, covering convertors for forced circulation water heating systems, capacity tables include the usual ranges for standard water heating systems. Also included are general ranges for radiant heating systems.

FOUR P-K CATALOGS YOU NEED

when specifying any hot water system...

AND HOW TO GET YOUR COPIES

With these four P-K catalogs on your desk you have installation and performance data, conveniently tabulated on instantaneous hot water heaters, storage water heaters, convertors for water heating systems and forced boiler water heat exchangers. Just write us for P-K heating equipment file #126 and we'll send you the set. The Patterson-Kelley Co., Inc., 1111 Warren Street, East Stroudsburg, Pa.

Patterson Kelley

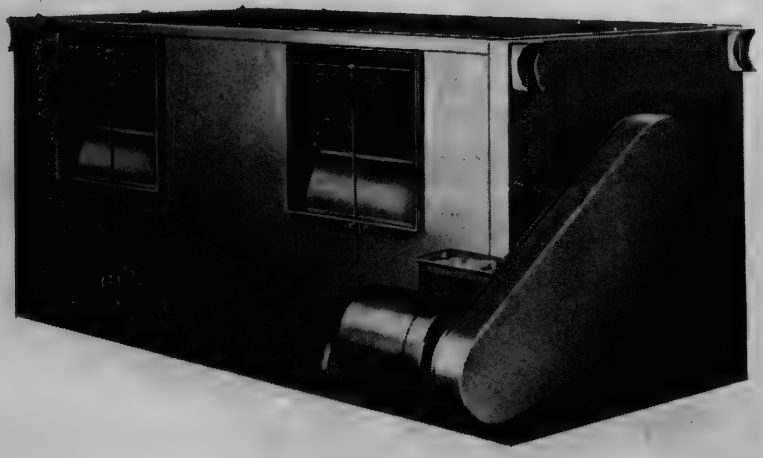
Water Heater Division

storage water heaters • instantaneous heaters • convertors • water to water exchangers

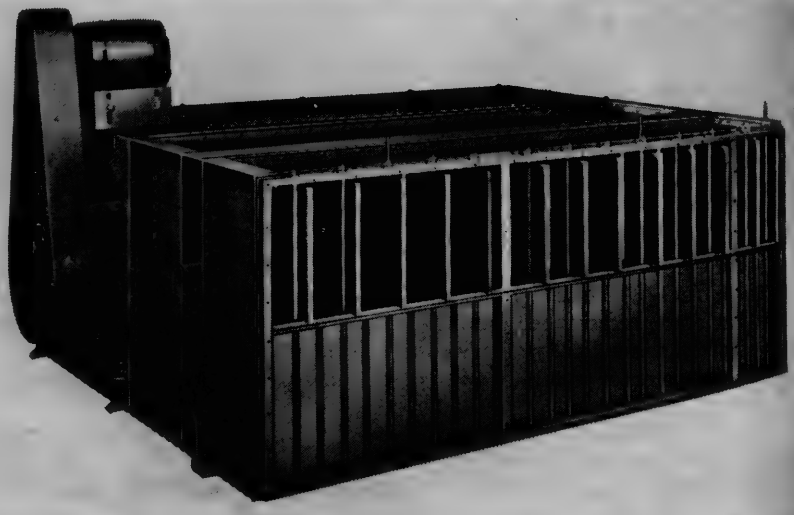
NOW! AMERICAN BLOWER DE

Heating and Ventilating Unit — Type V gives complete coverage of central-station heating and ventilating requirements. Steam or hot-water heating; large-volume, extra-quiet Sirocco Fans, for adequate heating and for ventilation. Ideal for offices, auditoriums, factory areas, gymnasiums, laboratories, schools and stores. Bulletin 8927.

Lineflow Ventilating Unit — Type L is a quiet, compact air handling unit for commercial and industrial uses. Designed for filtered air supply; fume and foul-air exhaust; air-conditioning zone distribution; and non-fouling kitchen and laboratory hood exhaust. Bulletin 8927.



Multi-Zone H & V Unit — Type VB provides individual zone control of temperature from a single central unit. Utilizes a "blow-thru" arrangement with individual zone dampers at the discharge end. Typical applications: schools, laboratories, offices and stores. Bulletin 8927.



DESIGNS NEW FLEXIBILITY INTO . . .

Heating and ventilating systems tailor-made with standard units

Sectional construction of basic components provides the required capacity, at savings in time, money and space!

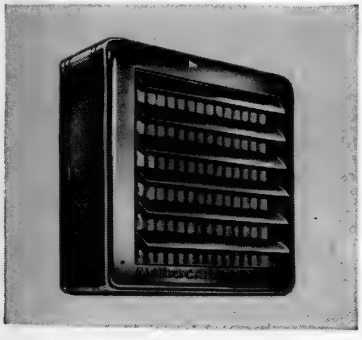
Want the efficiency and operating economy of a "tailor-made" heating or ventilating system? Need the lower initial installed cost of pre-engineered, "ready-made" components? Build around one of these three new H & V Units by American Blower!

American Blower Heating and Ventilating Units offer broad capacity coverage, with eleven sizes to handle from 600 to 66,000 cfm. New flexible design and sectional construction give a bigger selection of efficient combinations and space-saving arrangements to fit your requirements.

Units, coils and accessories assemble into a custom system at a packaged price. For example, there are eight unit arrangements based on fan rotation and discharge; four types of heating coils in a variety of arrangements with either top or bottom by-pass; and accessories such as filter boxes, face and by-pass dampers, damper-mixing boxes, and floor-base combinations.

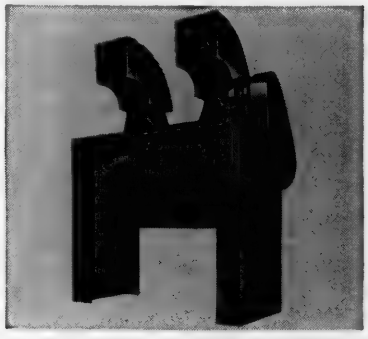
Every American Blower H & V component is precision-made for fast mounting and low-cost installation. Units are easy and economical to maintain and service because motors, drives and bearings are externally mounted, easily accessible. For full details, send for Bulletin 8927.

Remember: When you specify American Blower, you get equipment that's designed, engineered and manufactured to work together . . . *plus* one-source responsibility for its performance. Branch offices in 73 cities offer local product help or nationwide sales-service coordination. American-Standard,* American Blower Division, Detroit 32, Michigan. In Canada: Canadian Sirocco products, Windsor, Ontario.



Venturafin® Unit Heaters—for steam or hot water. Quiet; adjustable louvers. Horizontal or vertical. Bulletin 9017.

Cabinet Heaters—attractive, quiet. Models for all applications. Steam, hot water; to 1860 cfm. Bulletin 9617.



Industrial Unit Heaters—high-capacity, quiet. Universal cowls. Steam, hot water; 7 sizes, 4 arrangements. Bulletin 7727.

*American-Standard and Standard® are trademarks of American Radiator & Standard Sanitary Corporation.

AMERICAN-Standard
AMERICAN BLOWER DIVISION

weil SUBMERSIBLE SUMP PUMP

The only submersible approved by The Underwriters Laboratories, Inc.

Built for - Automatic Submerged Operation

A PACKAGED UNIT . . . . priced lower than many conventional Sump Pumps

Designed-

TO OPERATE UNDER WATER
Hermetically sealed motor with a leak-proof rotating shaft seal assures dependable performance at all times.

FOR ECONOMICAL INSTALLATION
Is easily installed in a metal tile or concrete sump 2' to 8' deep.

FOR SMALL SUMPS
Can be installed thru a 15" opening.

FOR GAS-TITE INSTALLATIONS

FOR FLOOD-PROOF OPERATION
If current fails moisture cannot damage pump or motor.

Choice OF **3** CONTROLS

MICRO-SWITCH
Fool-proof and trouble-free. Recommended for most installations.

ELECTRODE
For special installations where clear water is being pumped.

FLOAT SWITCH
For Duplex Units. Operates pumps alternately or together as conditions demand.

MOTOR: 1/3 HP, 1750 RPM, 110 volt **CAPACITOR TYPE** with 10 ft. waterproof cable and plug
IMPELLER: Non-Corrosive
SCREEN: Brass
BASE: Heavy duty steel
DISCHARGE: 1¼"
SHAFT: Stainless steel
DIMENSIONS: Height: 12¾"; Diameter: 11"; Weight: 50 lbs.

PERFORMANCE

Discharge Head (Ft.)	5	10	15	20	22	24
Capacity, GPH	3600	3350	2400	1830	1160	540

NEW MICRO SWITCH MODEL SS-805 ILLUSTRATED

Engineered for One Million Starts . . . without attention

weil PUMP CO.

1516 North Fremont Street
Chicago 22, Illinois

CLARAGE FANS FOR YOUR INDUSTRIAL AIR TRAVEL

Blowers and exhausters for diversified industrial applications.

Standard models promptly available.

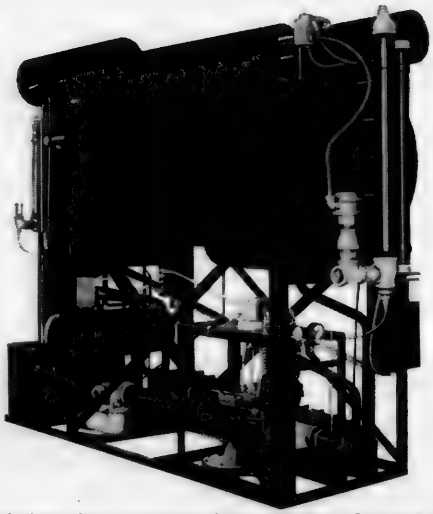
Clarage builds air handling and conditioning equipment exclusively — concentrated know-how!

When you want equipment designed and built for "the long pull"— to stretch your equipment dollar to the utmost — call on CLARAGE FAN COMPANY, Kalamazoo, Mich.

CLARAGE ... *dependable equipment for making air your servant*

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

ARCHITECT: JOHN F. STANN; CONSULTING ENGINEER: J. B. WYDLE; BUILDER: SAM EIG



Check these facts about the 25-ton **Arkla-Servel** Cooler

- A compact unit, easy to install and light enough for rooftop installation.
- Costs are low for installation, operation and maintenance. No specially trained operating or maintenance personnel are required.
- Can be installed singly or in banks to fit any size installation.

"...now we're cooling with GAS!"

Arkla-Servel Gas Air Conditioning keeps customers cool and operating costs down at the Motel Washingtonian

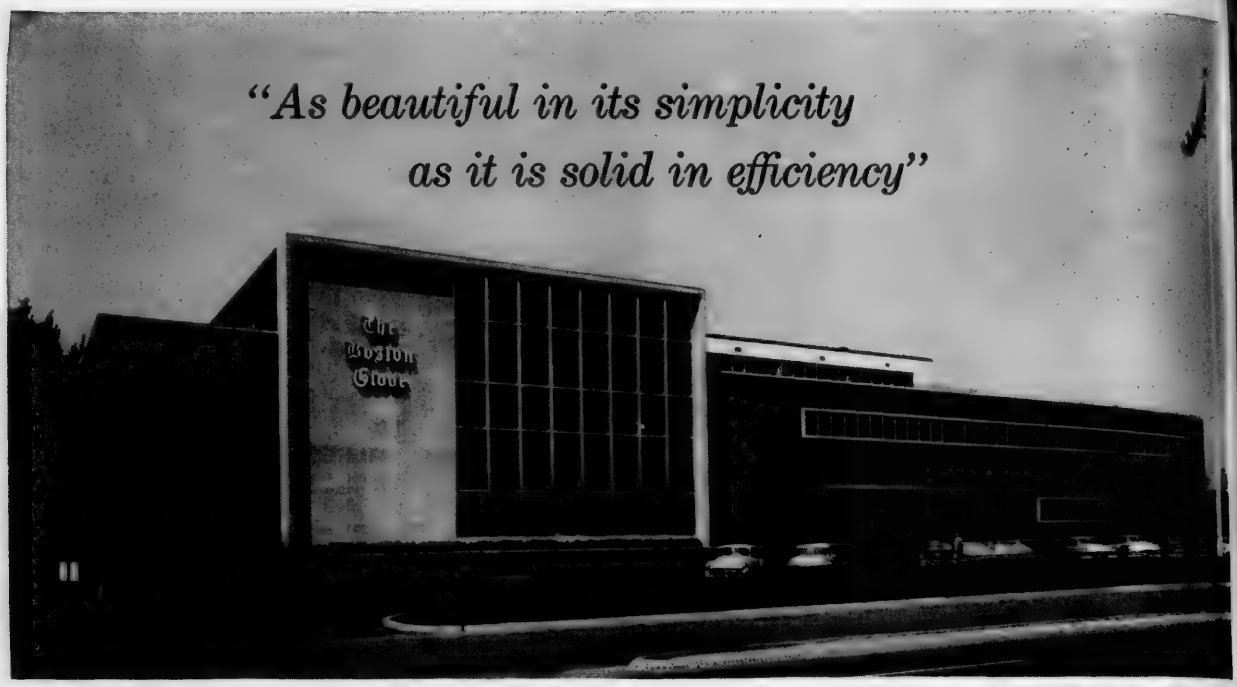
"While we were planning the Motel Washingtonian, we made a complete study of all potential equipment," states Sam Eig, builder and corporation president of this modern motel near Washington, D.C. "We knew we wanted gas for cooking and heating, and after our investigation, we found gas best for *all* operations."

For air conditioning, the specifications called for Arkla-Servel gas absorptive coolers. "With our Arkla-Servel units, we have no maintenance problems," adds Mr. McKeever and Mr. Eig. "And we were able to tie them into our heating system without worrying about special housing, vibration, or noise. Our one central system cools in summer, heats in winter to provide us with a quiet, year-round economical operation."

With the new Arkla-Servel gas absorptive cooler, your clients get extra—even exclusive—advantages that only a gas cooling system gives.

- High efficiency at all times—even during the light loads.
- Constant temperature control.
- Instant automatic adjustment to match actual cooling requirements.
- Dependability of fuel service at all times.

Gas absorptive cooling can put your commercial and industrial clients' heating plant on a year-round paying basis, too. For specific information, take advantage of the consulting services provided by your gas company. They have trained specialists who have been working with architects and engineers for years. Check the facts about gas and you'll see—modern gas air conditioning out-performs all other fuels. *American Gas Association.*



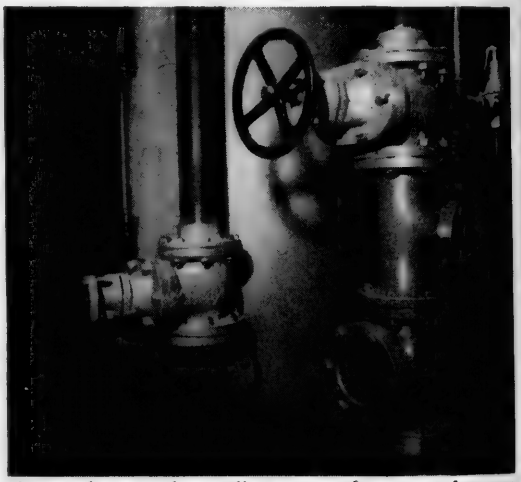
Architect and Consulting Engineer: GANTEAUME & McMULLEN, BOSTON • *General Contractor:* TURNER CONSTRUCTION COMPANY, BOSTON
Heating and Air Conditioning Contractor: THE MERRILL COMPANY, INC., BOSTON • *Plumbing Contractor:* M. AHERN CO., BOSTON

New Boston Globe Building relies on JENKINS VALVES

When the Boston Globe moved into this modern newspaper plant, it *made* news. A showplace for passersby with its battery of 37 presses turning out the news in a "picture window" two stories high, the new $12,000,000 home of the 86-year-old Globe is a model of efficient operation.

Efficiency is seen throughout the building plan. For example, practically all mechanical departments are on the first floor. The stress on efficient, trouble-free operation is equally evident in the equipment specifications which provided for utmost dependability in everything mechanical. To assure complete dependability in the control of water, air, gas, heating and air conditioning lines, Jenkins Valves were chosen.

Because of such confidence, "JENKINS" has been the trusted valve specification of three generations of building men. Yet the valves that have this well-earned confidence *cost you no more.* . . . Jenkins Bros., 100 Park Avenue, New York 17.



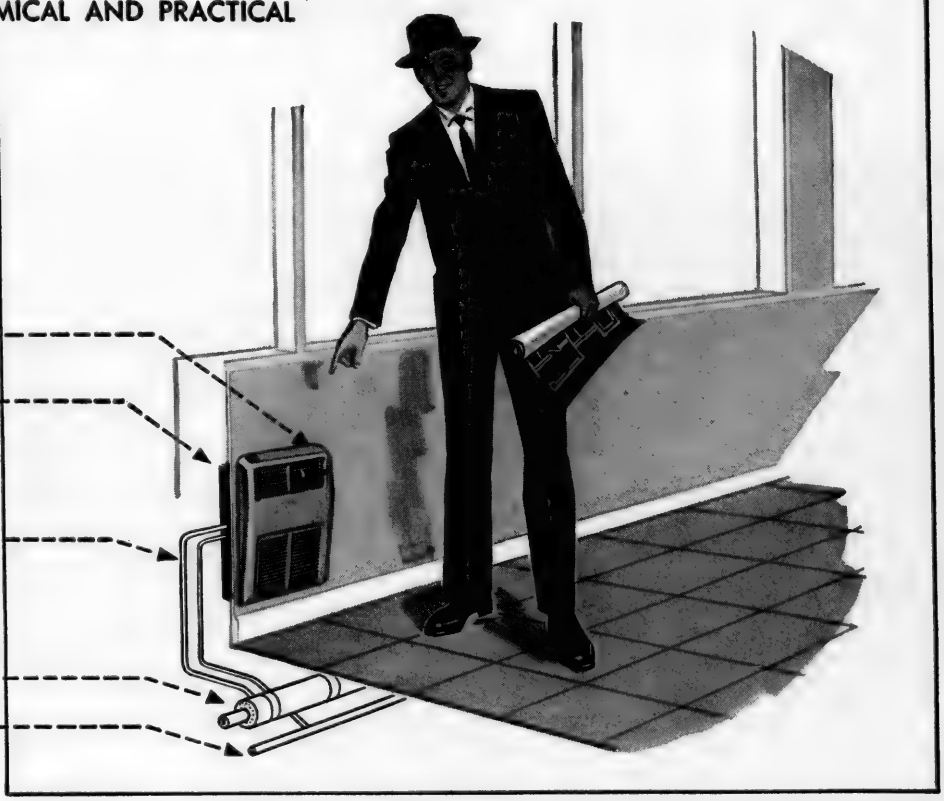
These valves on the cooling system for press plates are among 1,402 Jenkins Valves serving the 15-acre Globe building.

Sold Through Leading Distributors Everywhere

JENKINS
LOOK FOR THE JENKINS DIAMOND
VALVES
JENKINS SINCE 1864 Jenkins Bros.

ACCURATE ROOM-BY-ROOM TEMPERATURE CONTROL
NOW ECONOMICAL AND PRACTICAL

IRON FIREMAN SelecTemp® HEATING


THERMOSTAT
AIR HEATING, FILTERING AND CIRCULATING UNIT
Each room heater is an automatic unit, with steam heating core, air filter, steam driven fan and non-electric thermostat. Recessed in wall, requires no floor space.
COPPER TUBING
Low first cost. Substantial installation savings in new or existing construction. Flexible copper tubing concealed in walls and floors. Uses low pressure steam from boiler or district steam.
STEAM SUPPLY
CONDENSATE RETURN

New answer to old heating problems

The problem of room temperature control. SelecTemp heating is a new application of steam heat in which heat from a central source (low pressure boiler or district steam) is automatically regulated in each individual room. Temperature control is very accurate.

The problem of balanced heat. The warm and cool sides of a building are uniformly heated. A thermostat in each room automatically regulates heat according to room needs, compensating for any exterior or interior heat loss or gain resulting from wind, sun, fireplace, or a varying number of occupants.

The problem of varied temperatures for varied activities. In a school, for example, SelecTemp meets the different needs of classrooms, gymnasium, library or shop.

The problem of space. SelecTemp uses no floor space; compact room units, only 18" high, are recessed into walls. Steam supply and return lines of small copper tubing are concealed in walls and under floors. Extra space is not required for ducts or rigid pipes, permitting unusual design freedom, and in most cases, savings in construction costs.

The problem of modulated heat. Air circulation is steady. Temperature is controlled by regulating the amount of warmth delivered—not by stop-and-go cycling. Temperature is remarkably uniform from floor to ceiling and from corner to corner.

The problem of economy. With all its advantages, SelecTemp costs no more than many conventional systems not providing this unique automatic temperature control of each room. Fuel is saved because unoccupied rooms can be kept cool and reheated in a few minutes. Occupants do not waste heat through open windows. SelecTemp heating is equally suited for use in both new and existing construction.

SELECTEMP ROOM HEATER SPECIFICATIONS

	Model H-6	Model H-12	Model H-18
Output, Btu/hr at 10 PSI	6,000	12,000	18,000
Wall opening	17"x 6¾"	17"x 11"	17"x 15½"
Air Vol. CFM	60	120	180
Room heater supply line from main	⅜" O.D. Copper Tube		
Room heater return line to main	¼" O.D. Copper Tube		
Thermostat Range	40° to 90°		

See catalog in Sweet's Architectural and Light Construction Files

IRON FIREMAN®
Engineered HEATING AND COOLING

IRON FIREMAN MANUFACTURING COMPANY
3075 West 106th Street, Cleveland 11, Ohio
(In Canada write 80 Ward Street, Toronto)

☐ Send SelecTemp specifications and full information.
☐ Arrange for brief demonstration of SelecTemp room unit, in actual operation, in our office.

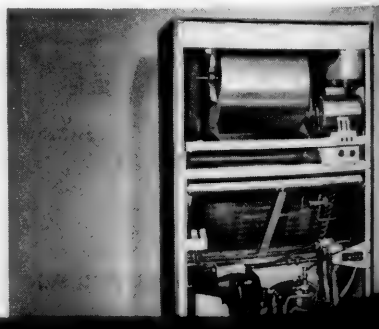
Name.....
Firm.....
Address.....
City.....Zone.....State.....

New models, new sizes, Trane Self-Contained

Air-cooled condenser (available for all sizes) features new, smaller dimensions, simplified piping and wiring for easy installation. Water-cooled condensers (all sizes) and evaporative condensers (10 through 20-ton sizes) also available.

Simplified construction speeds installation and service! All components of these new Climate Changers are easily accessible from front. Refrigeration cycle is easily removable for inspection, service on the job —or for in-shop repair or exchange.

Improved "iso-sound" design assures quiet, vibration-free operation. Cabinet and compressor housing completely insulated. Deluxe units may be installed in the conditioned space without disturbing occupants or employees.



new styling for Climate Changer Units

3 to 30-ton packaged units — air or water-cooled — are easier to install, easier to service

Here's the new line-up of TRANE Self-Contained Climate Changers for 1959: new air or water-cooled units in a complete range of sizes from 3 to 30 tons. And they're beauties! New, modern styling, clean, classic lines, smaller dimensions make them blend with today's office and store design. And, of course, these new units are engineered to the same rigid specifications that have made TRANE a leader in big building air conditioning systems. They're easy to install, too, with just a few simple piping and wiring connections. Extra rugged construction makes them easy to ship and to handle on the job. So for your next "packaged" cooling job, make it a TRANE Self-Contained Climate Changer! Call your nearby TRANE Sales Office for complete facts on these new Climate Changer units—or write directly to TRANE, La Crosse, Wisconsin.

CHECK THESE FEATURES:

- **Easy to install**—Smaller dimensions for easy handling. Internal wiring completed, with low voltage circuit that's easier, safer to work with. Readily accessible water piping connection (on water-cooled models). Sturdy construction, with components mounted on independent frame . . . no strain on external cabinet.
- **Easy to service**—All components easily accessible from front panel. Removable refrigeration cycle can be serviced in field, or entire unit may be easily removed for in-shop repair or exchange.
- **Streamlined appearance** — Modern lines and new design blend with office or store decoration. Equally well adapted for free-standing or recessed location. New decorative return air grille instead of conventional return air louvers. Low heights for balcony, roof or suspended installation.
- **Quiet operation** — New, large slow-speed fans with adjustable belt drive for extra quiet air movement. All moving parts isolated, with spring-mounted compressor that absorbs vibration. Casing insulated throughout.
- **Flexibility**—Complete range of sizes, types. Water-cooled, air-cooled and evaporative condenser models. 3 to 30-ton capacities. Both vertical and horizontal rear discharge available by simple on-the-job fan rotation. Large, efficient fans with larger h.p. fan motors give full air capacity—even with long duct runs.

For any air condition, turn to

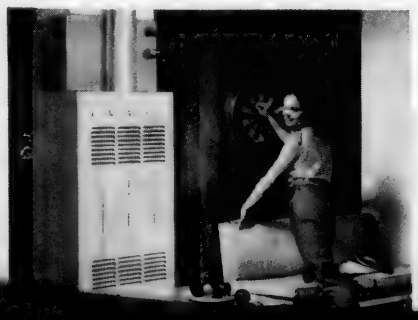
TRANE

MANUFACTURING ENGINEERS OF AIR CONDITIONING,
HEATING, VENTILATING AND HEAT TRANSFER EQUIPMENT

THE TRANE COMPANY, LA CROSSE, WIS.
SCRANTON MFG. DIV., SCRANTON, PA. • CLARKSVILLE MFG. DIV., CLARKSVILLE, TENN. • TRANE COMPANY OF CANADA, LIMITED, TORONTO • 97 U. S. AND 19 CANADIAN OFFICES

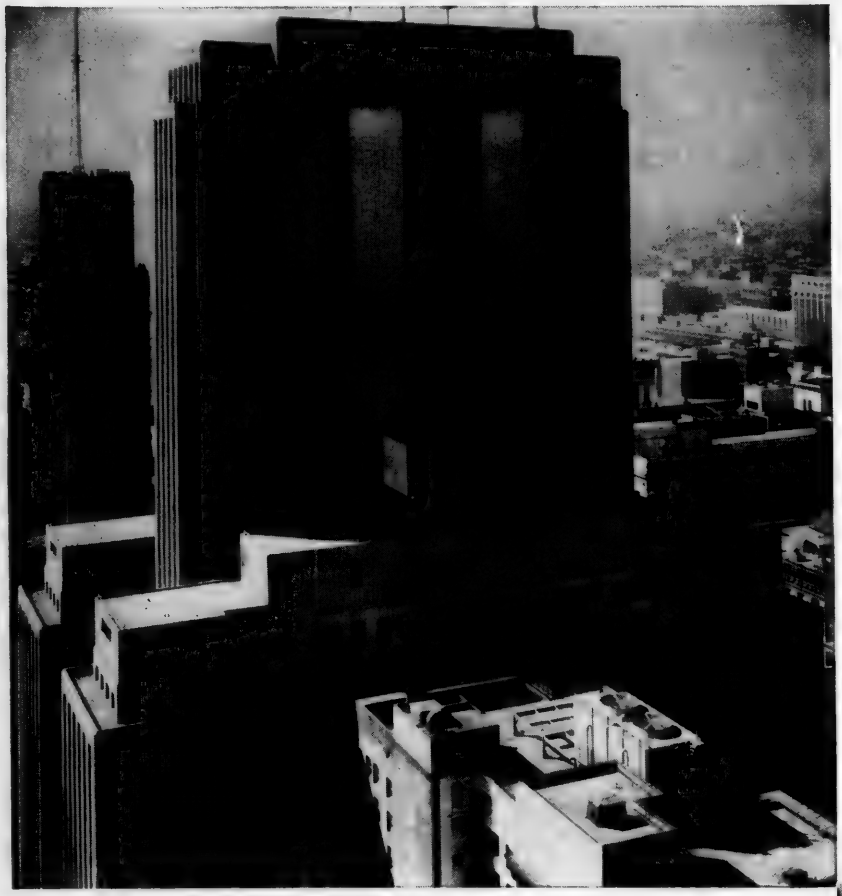
There's a Trane Climate Changer unit to cool any home, store or office!

Heat and cool with this new Climate Changer combination unit. Warm air furnace in both oil and gas-fired models . . . complete range of sizes and types. Cooling section available in 2, 3 and 5-ton capacities.



Save space with this compact Fan-coil Climate Changer! Tucks away in attic, closet, utility room—or may be installed behind partition or under ceiling. Provides crisp, cool air for store, home or office. 2, 3 or 5-ton.

No water needed! These TRANE Climate Changers are air-cooled, eliminating water supply and disposal problems. Compact condensing unit is located outside the home or building.

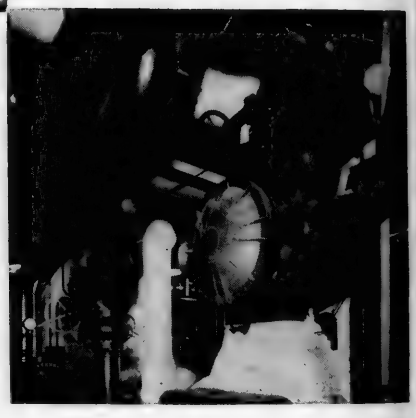


Air Conditioning with

USS National Pipe—

Chicago's Field Building

One of Chicago's landmarks, the towering Field Building on South LaSalle Street, recently completed the installation of a new air-conditioning system. USS NATIONAL Seamless Steel Pipe was used throughout the system—a total of 127 tons of it—in sizes from 3" O.D. to 18" O.D.



Need first-quality pipe for air-conditioning, heating and power installations? Need seamless steel pipe that will pay you back in outstanding service many times over for every dollar you spend? Then just say "NATIONAL Seamless." And, for further information or immediate assistance with your pipe problems, write to National Tube Division, United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pa.

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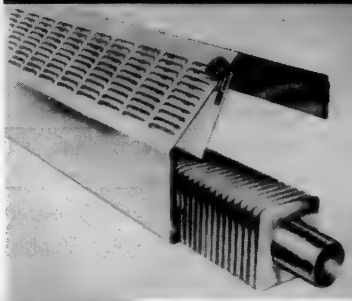
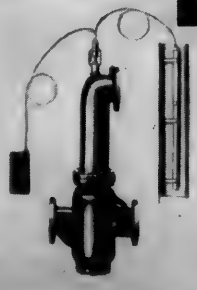
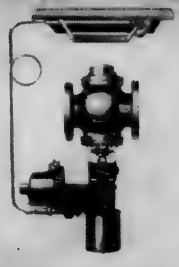


SARCOTHERM WEATHER COMPENSATED CONTROL SYSTEMS



Modulating Controls for hot water and radiant heating



Modulating Controls for steam heating

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5895-B

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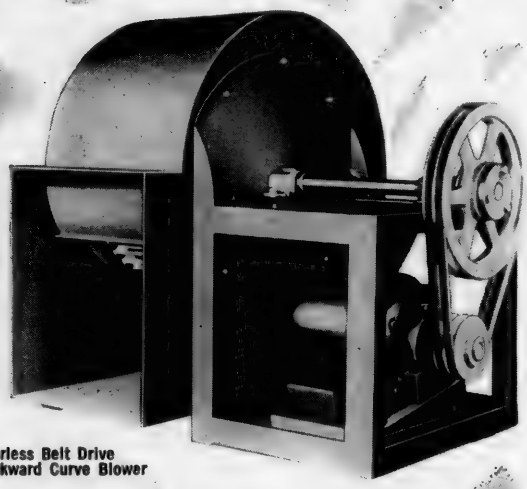
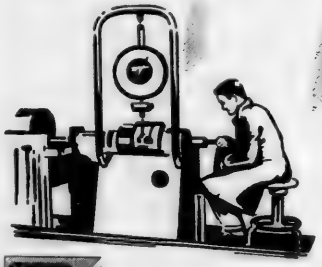


Peerless Belt Drive
Backward Curve Blower

Peerless Belt Drive
Centrifugal Roof Ventilator



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*The new Air Moving and Conditioning Association formed by merging PFMA, NAFM and IUHA.

As a member of AMCA, we are naturally vitally interested in listing and rating our air moving products according to AMCA specifications as set forth in the AMCA code. The products you see here are the two most important, basic products in our expanded line of air moving equipment. Along with other Peerless air moving units, they have been designed and manufactured to meet all AMCA standards. With this assurance, Peerless air moving equipment can be specified and installed with confidence. When you have an air moving condition which needs solving, call your nearby Peerless representative or the Peerless factory direct. We can all work together in helping you arrive at the best possible solution.

Write today for Bulletins SDA-160, SDA-200 and SDA-220!

A COMPLETE LINE OF AIR MOVING EQUIPMENT

Member of the Air Moving and Conditioning Association, Inc. (AMCA)

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steel pipe for vents and drainage, gas and water lines

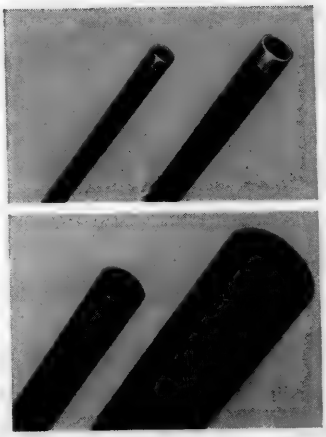
IN 500 CALIFORNIA HOMES —BETH-CO-WELD PIPE

Acre after acre of new-executive homes—that's the Grandview Palos Verdes community development, just south of Los Angeles.

And in each home, hundreds of feet of steel pipe—Beth-Co-Weld steel pipe, low in cost, long in service.

Used for drainage lines, for ventilation, and for gas and water lines, steel pipe combines the greatest strength and serviceability with the lowest cost. And for an added plus: Beth-Co-Weld pipe is made of top-quality steel by the continuous butt-weld method. That's why it's so uniform, so easy to work, and so thoroughly dependable.

When you're ready to build, consider the advantages of steel pipe . . . and specify Beth-Co-Weld.



Bethlehem steel pipe is available in sizes from ⅛ in. to 4 in. in continuous butt-weld, and from 5 in., nominal, through 16 in. OD in electric resistance-weld. Before specifying, write for Bethlehem's new *Handbook of Tubular Products.* Address: Publications Dept., Bethlehem Steel Company, Bethlehem, Pa.

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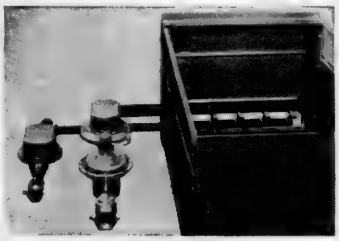
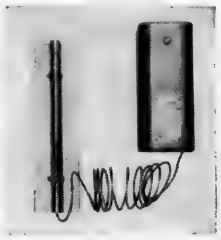
BETHLEHEM STEEL

BETHLEHEM STEEL

HERE ARE THE *EXTRA VALUES* YOU'VE WANTED IN A COMMERCIAL GAS BOILER



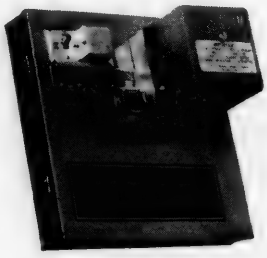
Dual Fuel Manifold and Base



Dual Fuel Control

DUAL FUEL MANIFOLD—optional

This optional feature permits the "J" Boiler to operate on natural gas during normal load periods and change over to LP Gas for low temperature peak loads. Both gases are properly burned within the same combustion zone.



PRE-WIRED ELECTRONIC CONTROL PANEL—optional

The Weil-McLain Model "CP" is a complete gas boiler control system built into a compact panel, factory-assembled and tested. The panel reduces electrical work to a minimum—assures lower installation cost as well as correct operation of the boiler and its electronic safeguard controls.

*Hydronics—the science of heating and cooling with water.

To schools, apartments, commercial and industrial buildings, the Weil-McLain Type "J" Gas Boiler offers dependable hydronic* heating at low operating cost. It is designed in every detail to burn fuel efficiently and to absorb a maximum amount of heat.

Cast iron construction assures long life, with minimum repairs. The "J" Boiler is easy to maintain at top efficiency...simply pulling out the clean-out plates makes the spaces between the sections accessible for cleaning.

The compact design of this boiler permits installation in a small boiler room—saves in construction cost. It's faster to erect because short draw rods simplify installation—assure a strain-free assembly.

The Weil-McLain Type "J" Boiler, in capacities from 625,000 to 5,000,000 A.G.A. input BTU/hr., burns all gases automatically and safely.

Send for engineering data

WEIL-McLAIN

TYPE J GAS-FIRED BOILER

WEIL-McLAIN
BOILERS · RADIATORS

WEIL-McLAIN COMPANY
MICHIGAN CITY, INDIANA

Address literature requests to Dept. BB-118

Huge 96" Acid Fume Fan—210,000 cfm "Buffalo" Axial Flow Fan with cast aluminum wheel, installed in a textile mill.

In Stack Hood Exhaust—Easy installation is a big advantage of the duct-size "Buffalo" Axials mounted in these stacks. Hoods give all-weather protection.

FOR TOP AXIAL FLOW FAN EFFICIENCY— IN BIG JOBS OR SMALL—

SPECIFY "BUFFALO" AXIALS

"Buffalo" Axial Flow Fans provide extremely quiet and efficient performance. This inherent efficiency is further improved by the "Buffalo" Vaneaxial outlet guide vanes. These carefully engineered vanes re-direct the swirling air at the fan outlet, converting it into increased forward thrust.

These sturdy, reliable fans are light in weight, permitting easy installation. Except for the largest models, no structural support or heavy foundation are required. "Buffalo" Axials can be installed as a section of the duct or stack in hood and other roof exhaust systems.

Duct-size "Buffalo" Axials save space by fitting in close to walls or ceilings. Space-saving installations include service as ventilation, exhaust and industrial air conditioning supply fans. They are widely used for applications ranging from paint spray booth exhaust to boiler room cooling.

"Buffalo" Axial Flow Fans are available for high or low temperatures, corrosive fumes, explosive atmospheres and other severe conditions.

Investigate the many advantages offered by "Buffalo" Axial Flow Fans. Contact your nearby "Buffalo" engineering representative, or write direct for Bulletin 3533-EF.

"Buffalo"

BUFFALO FORGE COMPANY

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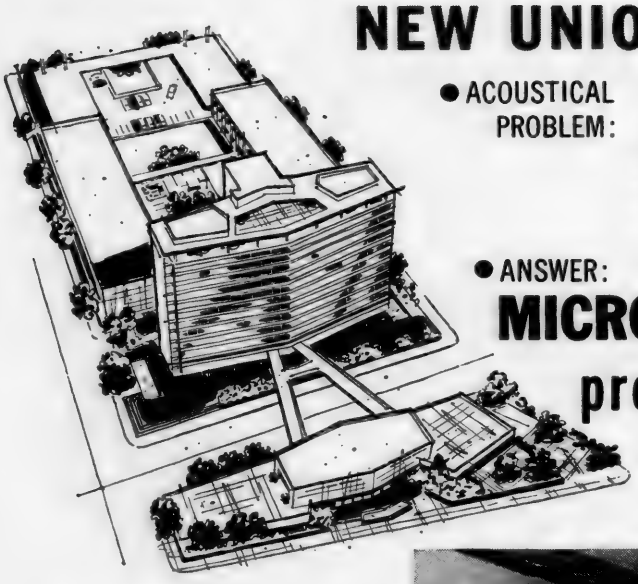
VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING
FORCED DRAFT COOLING HEATING PRESSURE BLOWING

NEW UNION OIL CENTER

Los Angeles, California

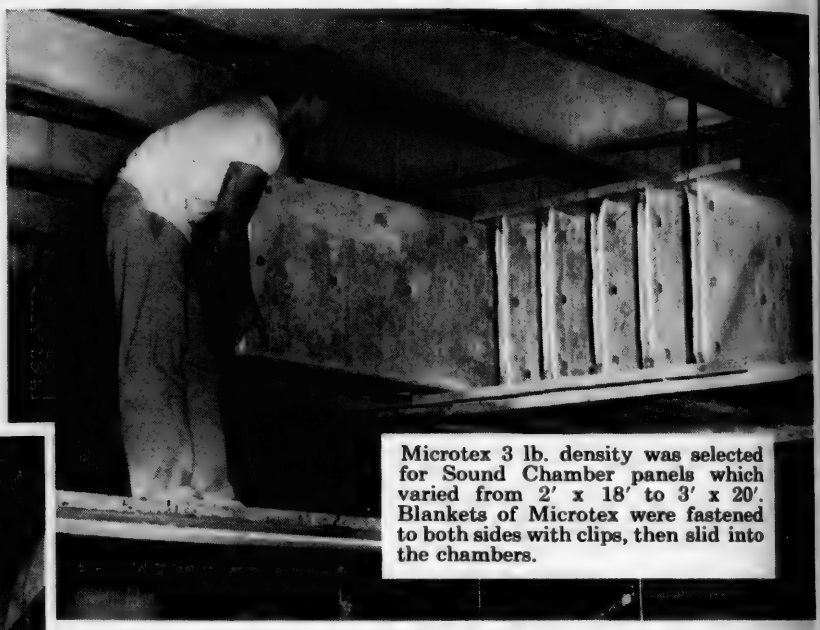


● ACOUSTICAL PROBLEM: **Supply duct velocity 3600 ft./min. Return ducts 1200 ft./min., with 8½ lbs. of static pressure: Unusually heavy equipment required to carry load; sound chambers needed to reduce high velocity noises; labor costs must be held to a minimum.**

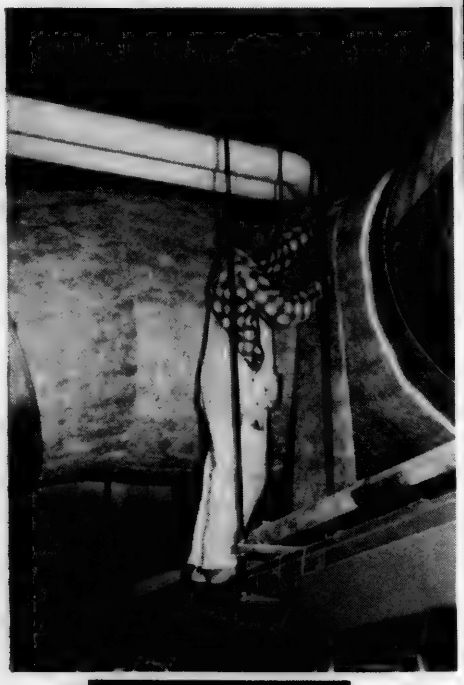
● ANSWER:

MICROTEX DUCT INSULATION provides notable insulation value per dollar

Eight carloads of Microtex Glass Fiber Insulation used in the largest air conditioning insulation job in the history of the West Coast.
Architect: Pereira & Luckman;
Contractor: Del E. Webb Construction Co.



Microtex 3 lb. density was selected for Sound Chamber panels which varied from 2′ x 18′ to 3′ x 20′. Blankets of Microtex were fastened to both sides with clips, then slid into the chambers.



Efficiency in Operation . . . Simplicity in Application

Nearly 80% of all insulation in the Union Oil Center is Microtex

Reason: Microtex absorbs fan and motor noises, soaks up sounds transmitted through the ducts, increases system efficiency. A low density, resilient blanket insulation, Microtex is made from fine glass fibers, bonded together, creating countless microscopic dead air cells which account for its high thermal and sound absorption characteristics.

For full information call or write any L·O·F Glass Fibers' sales office or distributor.

L·O·F GLASS FIBERS

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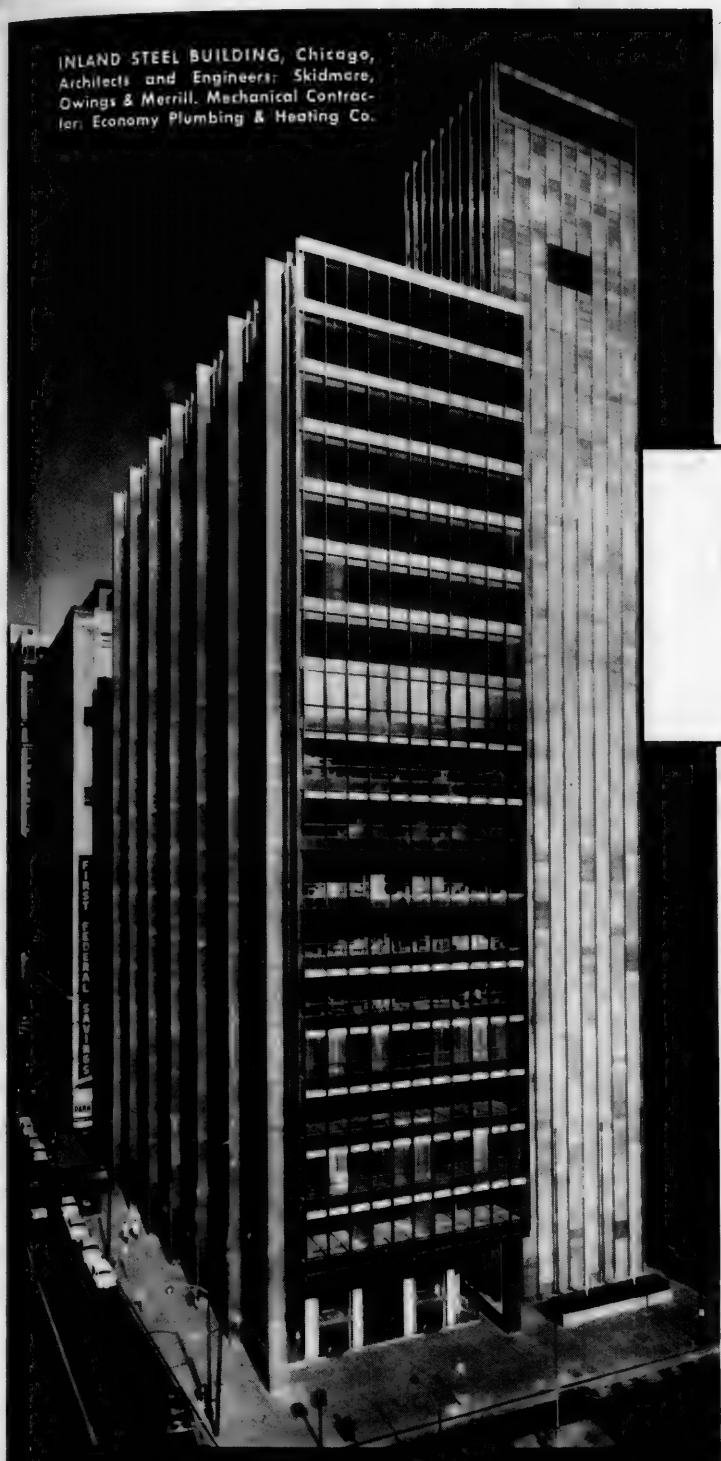


INLAND STEEL BUILDING, Chicago, Architects and Engineers: Skidmore, Owings & Merrill. Mechanical Contractor: Economy Plumbing & Heating Co.

INLAND STEEL BUILDING

CHICAGO

EXTERIOR MATERIALS:
68% GLASS • 32% STEEL

INTERIOR CLEAN AIR:
100% AAF!

AAF ROLL-O-MATIC FILTERS selected for striking new Loop structure

The Chicago Loop's first major new structure in 20 years—The Inland Steel Building—features an innovation in air conditioning design. Conditioned air—supplied by five dual-duct high-velocity systems—travels through cellular steel floors to perimeter outlets.

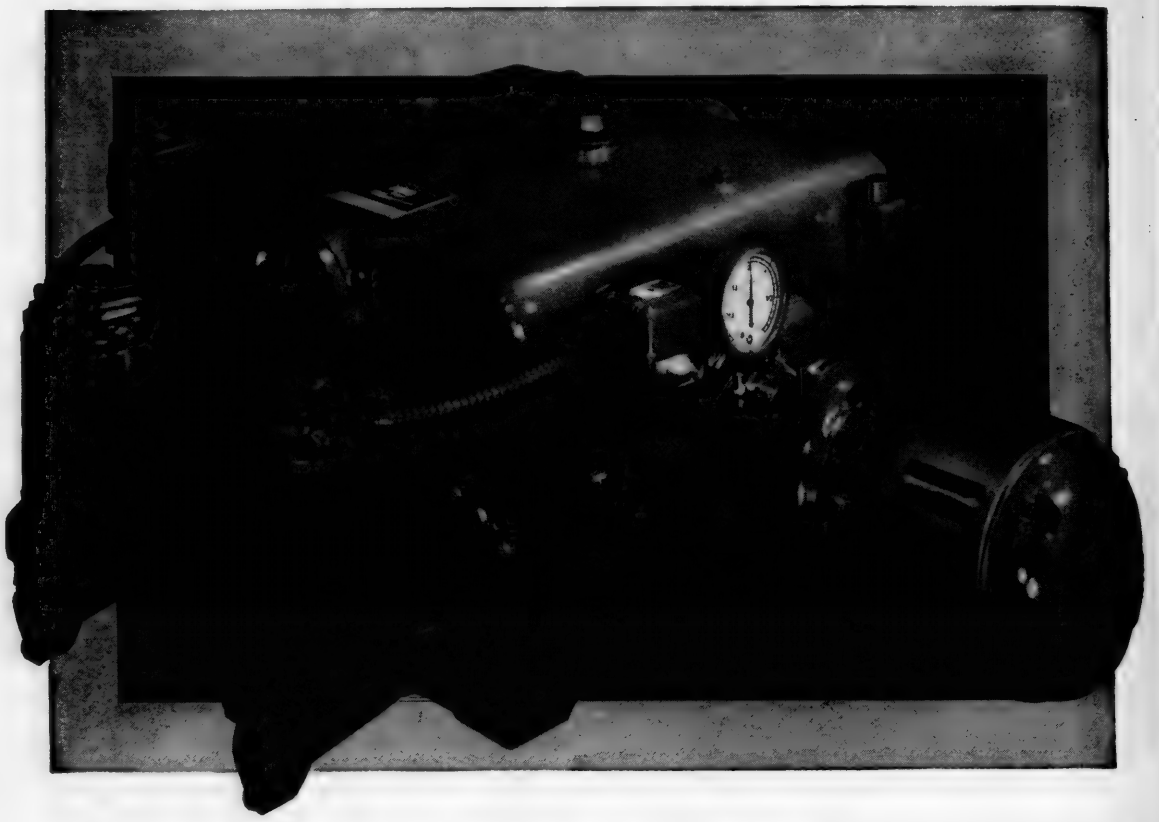
To *clean* this air (totalling 285,600 cfm), Inland Steel turned to a well-known success formula: installation of AAF Roll-O-Matic air filters. Roll-O-Matics are completely automatic, need no attention other than replacement of media roll about once a year . . . and *that's* as simple as changing the film in a camera.

For complete information on the Roll-O-Matic automatic renewable-media air filter, call your nearest AAF representative or write direct for Bulletin No. 248-C. American Air Filter Company, Inc., 294 Central Ave., Louisville, Ky.

AAF American Air Filter
COMPANY, INC. LOUISVILLE, KENTUCKY
American Air Filter of Canada, Ltd., Montreal, P.Q.

THIS NEW VACUUM HEATING PUMP

HAS THE INCREASED AIR CAPACITY EFFICIENT HEATING PRACTICE DEMANDS



It's the Nash CSM

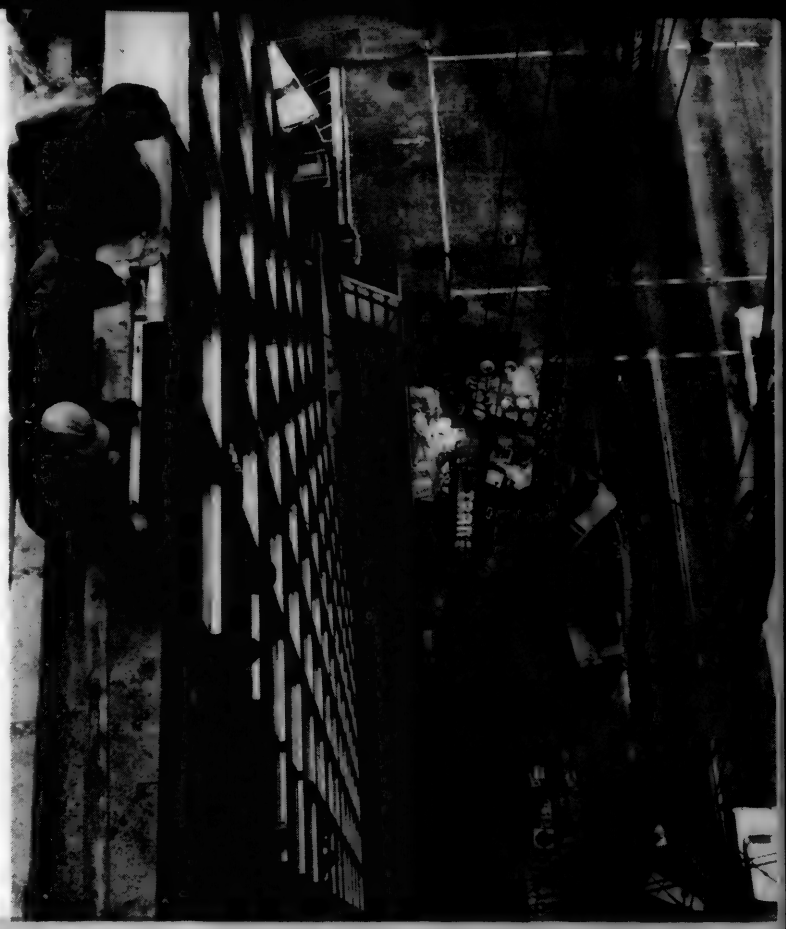
Designed and manufactured by the organization that made the Jennings Manifold Heating Pump standard of the Heating Industry, the new CSM incorporates every desirable feature architects, engineers, owners and operators have sought. Employing separate air and water pump elements, each with its own motor and each independently controlled by its own automatic switch, the capacities and arrangement may be widely varied to meet job conditions. For the first time, the engineer has the choice of realistic water and air capacities required for rapid system response without wasteful overheating.

These pumps possess many other features which permit a more efficient utilization of fuel and minimum use of electric power. Low, low returns reduce installation costs and usually eliminate putting the pump in a pit. Simplicity and efficient operation reduce supervision and maintenance costs. Information regarding this new heating pump development is available immediately upon request.

- Increased air capacity induces rapid system response without wasteful overheating.
- Separate air and water pumps individually selected to meet actual job requirements.
- Control system that operates individual pumps only when needed.
- Flexibility permitting addition of radiation without changing basic pump installation.
- Low, low, return line connection.

NASH ENGINEERING COMPANY
437 WILSON, SO. NORWALK, CONN.

The author singles out from the many systems extant four of the most popular air conditioning systems for multi-story buildings and argues the case for one of these, the fan-coil unit perimeter system.



For Multi-Room Air Conditioning—

Which System Is Best?

W. R. BARNARD

UniTrane Sales Department
The Trane Company, La Crosse, Wis.

THE SYSTEMS DESCRIBED

THERE is no one best way to air condition all buildings. There have probably been as many schemes as types of buildings. But by boiling these down to organized and often repeated methods, a dozen or so air conditioning systems can be identified. Many of these have fallen into relative disuse on multi-room, multi-story buildings because they were expensive or inadequate.

Low Pressure Single Duct Systems

The large central-fan system, utilizing low pressure ducts for distribution of conditioned air, is commonly used on industrial applications and for large spaces. The system can be installed by any competent sheet metal contractor at reasonable cost. All air circulated can be conditioned to control temperature, humidity, cleanliness and quality and the means of introduction can be arranged to provide proper, draft-free circulation. However, when used on multi-room structures, the lack of individual room control is a definite drawback. Control of temperature and humidity is interdependent, which makes the system particularly unsuitable for peripheral zones on multi-room buildings. Large equipment and ducts require high ceilings, large equipment spaces, and considerable floor space. Installation on existing buildings is undesirable because tenants are seriously inconvenienced, the system cannot be installed floor by floor, and because flexibility of the system to accommodate tenant changes is practically nonexistent. Although initial installed costs are low, annual operating costs are at least as high as better, more complete systems.

Low Pressure System with Reheat

A conventional low pressure single-duct system can be modified to improve the degree of control by adding zone or room reheat coils. This makes it possible to attain excellent sensible temperature control. The degree to which fan systems are decentralized greatly affects the flexibility of installation, particularly on existing buildings. This factor, plus the extent to which zone or room reheat is carried out, has considerable bearing on the

Wilfred R. Barnard joined The Trane Company in 1952 as a member of the firm's Sales Engineering Training Program after graduating from Pomona College with a major in physics. After graduation from the Trane program, he was assigned to the Air Conditioning Unit Sales Department and later named manager of the department's UniTrane room air conditioner sales. Prior to his Trane association, Mr. Barnard was superintendent of a cattle ranch and later employed in steel fabrication engineering.

cost of installation. In any case, initial cost is higher than for the all-air duct system without reheat coils. Operating costs are high, primarily because of the necessity for providing steam or hot water year-round. The system is not considered suitable for multi-room building work because in addition to high operating cost, the amount of space required for equipment and ducts is large.

Low Pressure Double-Duct and Zone Systems

Low pressure double-duct systems and multi-zone single-duct systems have a certain similarity insofar as application goes. The main differences are based on the degree to which individually controlled temperatures are available. A multi-zone unit mixes cool and warm streams of air at the unit prior to discharge through a zone duct into an area. The double-duct system distributes a supply of cool air and of warm air through ducts to each room or zone. Mixing dampers in each space allow selection of mixture temperature to each space as required by the occupant.

Each of these systems provides good sensible temperature control, with no independent control of humidity. In both cases, steam or hot water is required year-round. This means that both systems are characterized by high operating costs. The low pressure double-duct system does provide individual room sensible temperature control, but the cost of installation, cost of operating, and complexity of controls and balancing has caused it to become virtually obsolete. Furthermore, the two supply ducts and the third return duct, each sized for nearly 100% of air to be circulated, take up a great deal of space.

Low Pressure Induction System

Low pressure induction systems make use of a rather conventional medium pressure duct system modified to discharge the air near the outside walls. This was an improvement over other central duct systems where a source of heat under the window was important to overcome downdrafts in cold climates. Therefore, this was one of the first true year-round air conditioning systems which could operate without benefit of auxiliary heating sources.

Conditioned air, cooled and dehumidified in summer and tempered in winter, is introduced into low pressure induction units, once called blender units. This air, introduced at moderate pressures, is ejected through an adjustable air nozzle and induces a flow of room air through a secondary coil. The secondary coil uses hot water or steam only and is adjusted to heat the recirculated air to the point where it mixes, at about a 1:1 ratio, with the primary air to achieve the desired mixture temperature for discharge into the room. All of the cooling and dehumidifying is done by the primary air stream, and the dry bulb and dew point temperatures are set at the central air equipment to meet the worst design condition. In rooms where part loads are encountered, blending of warmed air lowers the net cooling capacity as required. Some independent control of humidity is available by varying the amount of primary air with the adjustable nozzle and by proper control of the secondary coil.

Since the duct system carries medium velocity or medium pressure air in about the same quantity as on low pressure duct systems, the size of the duckwork is reduced, saving space. However, greater care must be taken in fabrication of ductwork, and with the additional lengths required to run out to the perimeter units, costs are high. Furthermore, addition of the blender units and the piping system required makes this a very high-cost system. Steam or hot water is required year-round. Central fan equipment must be selected for higher discharge pressures. As a result, operating costs are about as high as costs of the most expensive systems.

Low pressure induction systems have become nearly obsolete, except on schools and laboratories where large ventilation requirements are encountered. They are adaptable in those cases with 100% outside air handled by the primary air system.

Unit Systems

Unit systems represent refinements of the trend toward maximum individual room control. Depending on the system, anywhere from 75 to 100% of cooling and heating capacity available in a space may be controlled by the occupant. The unit system utilizes fan-coil room units supplied with hot or chilled water. In the main, unit systems are versatile and economical and may be adapted to gain any degree of control which is commensurate with the desired cost. Except in the degree of control expected, there are very few disadvantages. They have a low first cost, are easy to install, and may be installed floor-by-floor—even room-by-room. They take up a minimum of floor space and little, if any, ceiling height. There is great flexibility in altering the systems to meet tenant changes.

Unit systems may be designed to handle recirculated room air only with a sacrifice in control of humidity and air quality, but at low initial cost. They may be used with wall intake or ducted intake of outside air, providing control of air quality, but still falling short on independent control of humidity. Finally, with ducted conditioned central ventilation supply, complete control of air quality and humidity, at a higher initial cost, but at a moderate operating cost, is obtained.

Unit systems have become the most popular and widely used devices for air conditioning multi-room buildings. The best arrangement of a unit system is one in which fan-coil room units are located in the perimeter spaces of a building to accommodate changing skin loads. A separate high, medium, or low pressure duct supplies the proper quantity of preconditioned outside air into the perimeter space. This is introduced at any convenient point in order to meet ventilation requirements, to offset latent heat loads in the space, and to provide adequate total cooling capacity during change-over periods. No return duct system is required, as ventilation quantity is exhausted.

A study of the psychrometric chart, Fig. 1, will show

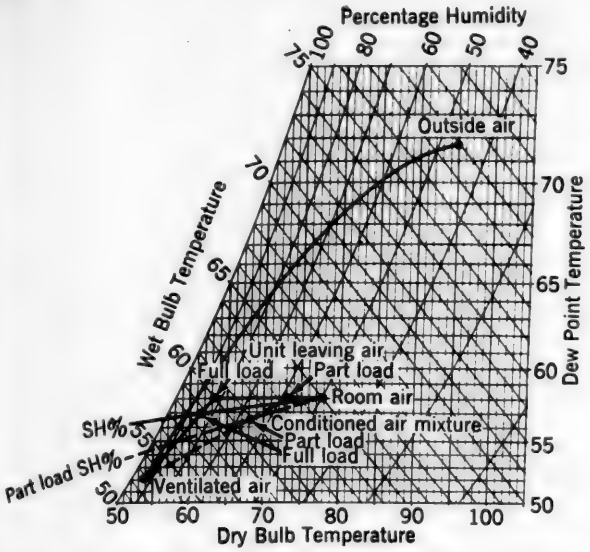


Fig. 1. Summer cycle of the fan-coil room unit system with central ducted primary air.

that this combination system fully meets the requirements for maximum control.

High Pressure Induction

Another popular big-building system, the high pressure induction system, utilizes induction room units located in the perimeter spaces of the building to accommdate changing skin loads. A duct supply of preconditioned outside air introduces the proper quantity to each room. This is introduced at the unit in order to meet ventilation requirements, to offset latent heat loads in the space, to provide adequate total cooling capacity during change-over periods, and to make the induction units operate. In nearly all cases, the last requirement is the governing factor and increases the primary air quantity over that established by the other requirements. The primary air must be at high pressure and must be introduced at the unit. No return duct system is required, as ventilation quantity is exhausted. The plot of this system on the psychrometric chart, Fig. 2, is identical to that of the system with fan-coil units and separate central ventilation supply insofar as ability to provide control is concerned.

High-Velocity Double-Duct System

A third popular big-building system, a typical double-duct system, uses a central fan system or decentralized systems which cool and dehumidify a mixture of 25% outside air and 75% return air. This mixture is proportioned into two ducts and the air in one duct is reheated to a moderately warm temperature. The warm and cold ducts are extended to a series of high pressure mixing boxes located under windows or above the ceilings of perimeter spaces. These mixing boxes take a mixture of air from the warm and cold decks as required to meet room load requirements. The mixing boxes attenuate high velocity noise, reduce pressure for introduction to the room, and control mixture temperature. A return duct system returns 75% air to the central fan equipment, the 25% ventilation quantity being exhausted.

The plot of this system on the psychrometric chart, Fig. 3, illustrates good control of sensible temperature but inability to accommodate latent loads in individual spaces which exceed design latent loads.

Radiant Cooling System

The fourth big-building system to be studied, employing radiant cooling panels, follows the lead of radiant heating systems except that it has refinements which provide more efficient heat transfer and more immediate response. The system utilizes a highly conductive panel which consists of a metallic surface sheet which is bonded or mechanically fastened to a water tubing grid. In most cases, the panel is formed by a type of drop ceiling. Heat from occupants and warm objects in the room is radiated to the cooler surface sheet during the cooling cycle, then conducted to water

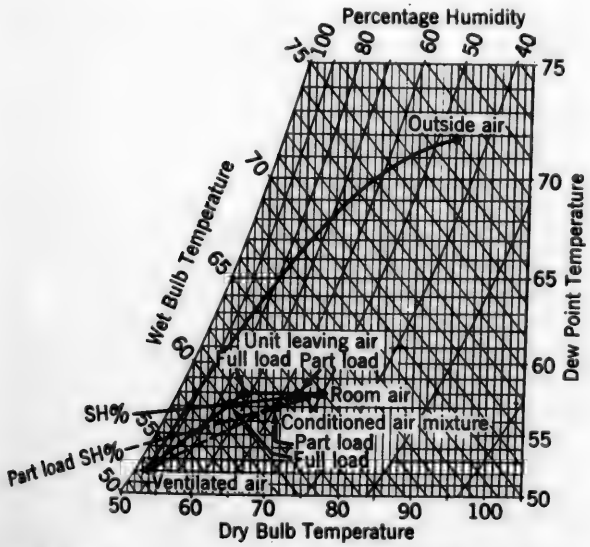


Fig. 2. Diagram of summer cycle of a typical high pressure induction system.

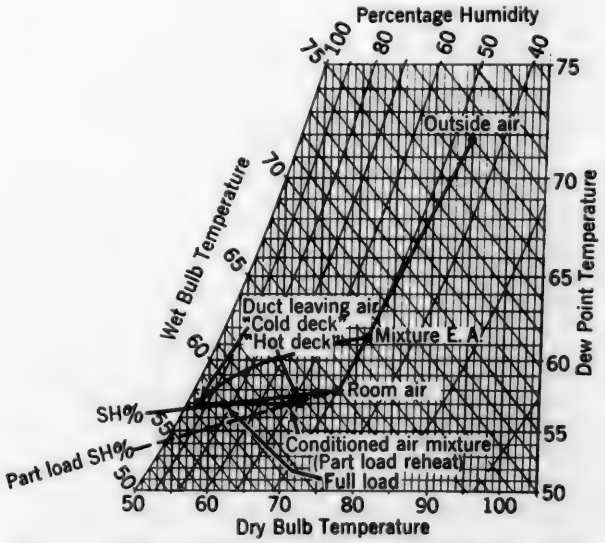


Fig. 3. Diagram of summer cycle of a typical high velocity double duct system.

circulating through the tube grid. The radiant panel generally accommodates 40-50% of the sensible heat load in the space. A conventional duct introduces the proper quantity of preconditioned air to each room to meet ventilation requirements, to offset latent heat loads in the space, and to accomplish 50-60% of the sensible heat capacity required for the space. In most cases, the duct system handles half of the air required for an all-air central duct system and includes 50% outside air and 50% return air. In order to attain any degree of humidity control, the duct supply of air should have room reheat. This results in closer response to changing sensible heat percentages. A return duct system is required for 50% of the air in the supply duct.

The operation of this system is difficult to plot on a psychrometric chart because the capacity of a radiant cooling source does not involve air temperature change which reflects on the chart. A "ceiling air" temperature point is established on the psychrometric chart, Fig. 4, by deducting the heat absorption effect of the panel from the room sensible load. A mixture line drawn from this point to the duct leaving-air point intersects the sensible heat percentage line.

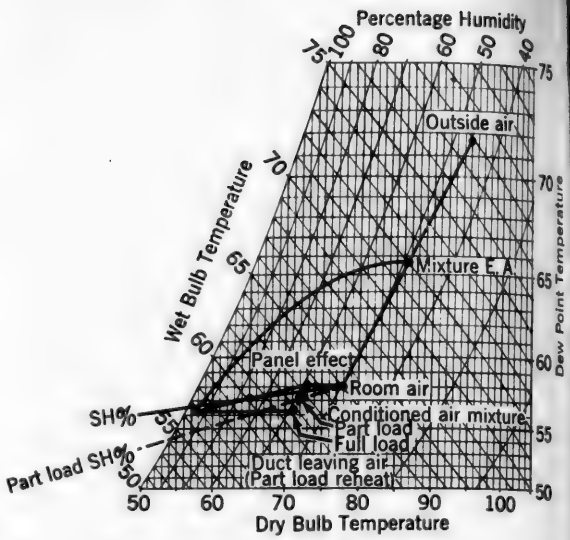


Fig. 4. Diagram of summer cycle of a typical radiant panel cooling system.

TOP FOUR SYSTEMS EVALUATED

Fan-Coil Room Units

The combination of fan-coil units and primary air system makes possible complete year-round temperature control. The two air streams provide heating or cooling during change-over periods. Independent control of humidity is truly available only on systems with double coils and double air streams. The fan-coil system makes use of dehumidified primary air to accommodate design latent loads. When latent loads increase in any space, the presence of an efficient cooling coil within the space will immediately condense moisture and tend to compensate for it at the source. However, complete dew point control is not available independent of dry-bulb control.

Primary air, consisting of conditioned outside air, is introduced in quantity to meet ventilation requirements. Primary air is completely filtered. So is all recirculated air passing through the fan-coil room unit.

Fan-coil room units are capable of circulating air within a room 30 ft deep. Even on reduced speeds, discharge velocity and directional control assure proper circulation. This also assures complete mixing of unit and duct air within the conditioned space.

A fine degree of control is available to the room occupant. Typically, the fan-coil room unit accounts for about 80% of the total room capacity. He may also exercise control over 90% of the air circulation in the space through the unit fan motor control.

Fan-coil room units may be installed anywhere that piping and electrical connections are available. With proper planning, this means that units may be located or relocated at any point on the outside wall. Since primary air may be introduced at any point in the room and not necessarily at the unit, this does not directly affect relocation of units. Of course, changes in the duct system may be required because of partition changes. Fan-coil units may be readily replaced by units of greater or lesser size at a minimum cost and without changes in primary air quantity.

The small size of primary air ductwork is proportional to the small quantity of air which must be handled by the unit to meet ventilation requirements. Usually the size of low pressure rectangular duct does not exceed the overall diameter of high pressure duct to handle the additional quantity required by other systems. Furthermore, this duct may be run in convenient areas without taking up valuable floor or ceiling space.

The fan-coil unit system is the least costly of the four quality systems to install. A nominal figure of $1000 per ton for new buildings and $1100 per ton on existing buildings may be mentioned. Average operating cost for full load year-round operation is about $54 per ton per year. This is based on electricity at $.01 per kwh and $1.00 per 1000 gal of water.

Part-load operating cost is a very important consideration to the owner. Fan-coil units can be turned off in unoccupied spaces, and the primary air system may be shut down over weekends and off periods, so that the cost of operating is nearly proportional to the cooling capacity requirement.

High Pressure Induction

The high pressure induction system provides complete control of sensible temperature year-round. The availability of two air streams makes intermediate season control possible. Although there is a coil in each room, it is usually selected to do sensible cooling only. As a matter of fact, one manufacturer often recommends an automatic control for shutting the coil off if dew point temperatures rise in the space in order to eliminate drain lines. This effectively limits the ability to accommodate excess latent loads. In any case complete independent dew point control is never available.

Lack of filtration on recirculated air is an appreciable drawback with many of these systems. Circulation of air from induction units is not particularly good. One normally does not expect to attain acceptable circulation in a room more than 12 or 15 ft deep. Improvements

have been made by way of increased induction ratio, but circulation is far less effective in these low powered units than in fan-coil units or even in good ceiling or sidewall diffusers in an all-air system. However, since introduction of air is generally under the window where it counts, circulation may be considered acceptable.

The induction system provides only for control over the secondary cooling capacity by the room occupant. This is about 65-70% of the total capacity in the space. There is no control over primary air capacity or quantity. There have been cases where primary air dampers were arranged for occupant control but this is likely to upset the balance of the system. Even though temperature and humidity of the primary air are controlled at a central point, this is not within the realm of individual room control. Room control, then, is basically available over 70% of the total capacity and none of the air circulation.

The greatest flexibility of installation occurs with an induction system when a unit is located under each window. In such case, partitions may be moved readily because the air conditioning is practically continuous. However, from the standpoint of cost, this is sometimes prohibitive. It is more common to see three units under five windows in a bay. But necessary changes in unit size or location are complicated and costly.

Initial installation of an induction system is rather complicated. Ducts require special vertical chases or horizontal runout spaces, both of which are larger and more space-consuming than piping alone would require. On existing buildings, a great deal of cutting and patching is normally required.

A high presure induction system will generally cost 5 to 10% more to install than a fan-coil room unit-primary air system. A cost of $1100 per ton for new buildings and $1200 per ton on existing buildings is estimated.

The main reasons for the higher cost are: larger central-fan equipment for higher primary air quantities; larger regriferation equipment for the higher outside air load; greater number of room units required, in spite of lower unit cost, and more expensive ductwork.

Full load operating cost of an induction system runs up to 10% higher than a fan-coil room unit-primary air system. However, one may assume an average figure of about 4% which gives an annual cost per ton of $56. In spite of the large number of small fans on room units in a fan-coil room unit system, the additional horsepower required to handle greater amounts of primary air at high pressure more than balances it out. Added, then, is the increased refrigeration horsepower for the higher outside air load.

Part load operating cost is a different story. Under mild weather conditions refrigeration load is reduced but fan horsepower remains the same. Moveover, during off hours or over weekends, the air system must run 100% to get any air conditioning at all.

High Velocity Double-Duct

In this comparison, manual temperature control of the mixing damper is assumed, as well as automatic compensating devices to maintain a constant mixture quantity. Both ducts are high pressure ducts. Each handles a mixture of outside and recirculated air. The mixture may be introduced at any point. Two constant sources of air—one warm, one cool—allow close and immediate control of dry bulb temperature.

Considering the basic system where both hot and cold deck air have been dehumidified, there is provision for humidity control. However, it is not possible to control dew point temperature independent of dry bulb temperature. There is no cooling coil in the space to accommodate increased latent load. A rise in dew point temperature of the room cannot be compensated for until return air from the room mixes with all other return air, goes through an averaging process and causes an increase in central system latent capacity. This is not good humidity control.

A constant volume of air is introduced into each space, of which 25% is outside air, providing adequate ventilation. However, because at least 75% is returned to the central fan and redistributed to the system, transmission of odors, fumes, smoke, and germs is a probability.

All of the air in the system is filtered.

With the improvements made in high presure attenuating, mixing and diffusing device design, air circulation can be attained to a good degree. These devices may be located under windows, important in cold climates, or above ceilings. Since ceiling outlets are a good deal more common, even in cold climates, circulation can be said to be less than ideal for all applications.

Although the room occupant has complete control of room temperature, he has no control of air circulation. Installation can be complicated and can require a good deal of space since two supply and one return duct are needed. This is especially true where under-window mixing devices are used. Even where ceiling units are used with overhead horizontal ducts, there is enough space required to reduce ceiling heights a foot. On existing buildings, cutting and patching is serious, even prohibitive for under-window units.

A double-duct system requires a large amount of expensive spirally wound or pressure-tight rectangular ductwork. There are a great many pressure-tight joints to make up in the field. The attenuating, mixing, diffusing devices are costly, often running two to three times as high as a fan-coil unit, if automatic controls are included. Being an all-air system, central fan and coil equipment is large and designed for medium pressure. Information from several sources indicates that initial cost runs up to 20% higher than for the fan-coil room unit-primary air system. We have heard of some that are comparable and a few stand out as costing less. Even our most conservative evaluation places the cost per ton at $1000 for new buildings and $1100 for existing buildings. These figures are based on manual mixing damper controls which are seldom encountered. To give control at all comparable to a fan-coil system with manual control, some automatic control is required. This would raise the cost per ton to $1100 and $1200 respectively.

An all-air system operating at medium pressure will require a large fan operating horsepower. On the assumption that at least four times as much air is circulated as on the primary air system of a fan-coil room unit system and twice the pressure, the central fan horsepower will be at least sixteen times as great. It is necessary to have steam or hot water available year-round. The operating cost of a high velocity double-duct system is in the vicinity of $66 per ton per year. This is 41% higher than a fan-coil system.

Part load operating cost is reduced only in refrigeration capacity and is not realized to the extent that it is in other systems because of the method of dew-point-

controlled cooling and reheat. There is no saving in fan system horsepower during part loads or during off hours, for the system must be in 100% operation or off. A greater variation between refrigeration load requirements and horsepower requirement because of the cool and reheat method is inevitable.

Radiant Cooling System

The radiant cooling system to be evaluated consists of a radiant ceiling panel of the type in which tube grids are fastened mechanically to aluminum surface sheets. The lighting fixtures are recessed in troffers which are assembled as part of the ceiling. In addition to the radiant ceiling, a conventional low pressure, single-duct system is installed with room reheat. This duct handles 50% of the air normally required for an all-air system, or about 200 to 250 cfm per ton. Half of this air is outside air and the mixture is delivered through the ducts at about 54 to 56 deg F dry bulb. Assumed are manual valve control on the room reheat coils and no control on the radiant ceiling tubes. Generally, the water in the radiant ceiling runs wild, and control is attained by control of room reheat.

The radiant cooling panel is intended to absorb radiated heat from objects in the room, especially lights and people. It does sensible cooling only. The balance of sensible cooling is done by the duct system with room reheat coils. Each source handles about half of the sensible load. During change-over periods, one source may be warm, the other cool, allowing good year-round control of temperature.

Dehumidification and humidification are supplied by the central duct system as required for over-all building conditions. There is no provision for increasing latent cooling capacity if the room latent load is increased. As a matter of fact, increased latent loads would be a serious problem because the radiant panel might start to condense moisture and cause serious damage or at least complaints. There is no control of dew point temperature independent of dry bulb temperature control.

Outside air is introduced through the duct system in sufficient quantity to meet ventilation requirements. However, since there is at least 50% return and recirculation of room air, odors, smoke, fumes, and germs can be transmitted from one space to another. Since the proportion of outside air is higher than for an all-air system, transmission of air from one space to another is not too great, however.

All of the air in the system is filtered.

Circulation of air generally comes from sidewall diffusers. Proper design of these can attain good air circulation, but does not provide for elimination of downdrafts from windows.

The room occupant has control of the room reheat coil on the duct system to vary the room temperature. As pointed out earlier, the sensible capacity of the duct supply is 50-60% of the total room sensible capacity. There is no control over circulation of air in the basic system.

Very often radiant ceiling panels are continuous throughout a floor of a building. As such, they provide a fixed heat absorption or emission per square foot. If partitions are of the temporary or movable type, it is possible to terminate these at the ceiling panel. However, on first class construction, partitions are generally wood framing with plaster finish. This dictates modification of the ceiling panels and recircuiting of the water piping. In addition, any relocation of partitions will require changes in central ducts, diffusers, and reheat coils.

Initial installation on new buildings is not complicated, but it must be understood that the radiant ceiling panel is installed at least 6 inches below any normal ceiling construction. Moreover, the sidewall diffusers for the air supply come in below the radiant panel. The alternate method, and one which is seldom encountered, is to discharge air through ceiling diffusers which would interrupt the radiant panel ceiling. In either case, the dimensions of the ductwork, diffuser, and ceiling panel are additive and the sum must be considered as some penalty in figuring floor-to-floor building height. Actually, less space is consumed on this system than on the double-duct system.

The radiant cooling panel system is the highest priced of the four being compared. The installed cost is about 40% higher than the fan-coil room unit system, or about $1400 per ton. However, it is possible to take a credit for the acoustical treatment afforded by the ceiling panels. This would cut approximately $200 per ton for the air conditioning alone if an acoustical ceiling was to be figured in anyway. Giving this the benefit of the doubt, we can assign a cost of $1200 per ton on new buildings and $1300 per ton on existing buildings.

Operating cost of a radiant panel system covers the cost of the radiant panel itself for half the load and a central duct system with room reheat for the other half. The weighted combined operating cost is about $67 per ton per year. This is 43% higher than the fan-coil room unit system.

Part load operation is reduced in cost only because of the reduction in refrigeration required. Unless controls are provided in the radiant panel water circuit, they run continuously as long as any part of the zone or system is in operation. The duct system likewise runs at all times at fixed horsepower because there is no speed control. It is not possible to shut off the duct system during off hours without shutting down the radiant cooling circuit, otherwise condensation could cause damage. As a result, the system is either 100% on or off.

SUMMARY

All of the systems dealt with are considered high quality systems. However, it is interesting to note that the largest difference occurs in the extent to which humidity control is afforded.

Degree of control specifically relates to the extent to which the room occupant can affect his own environment, independent of any other space on the zone or the system as a whole. With the control of air circulation as well as the large portion of capacity, the fan-coil-primary air system stands well above other systems.

All of the systems are well suited to installation on multi-room buildings. Any of them is readily adaptable to new buildings. All of them are susceptible to tenant change modifications, the radiant panel least.

Gaging Chart for Cylindrical Tanks

This gaging chart permits the rapid and painless calculation of the contents of partially filled horizontal, spherical, and vertical cylindrical tanks with different types of heads. Until its development by the late Sybren Ruurd Tymstra, professor of mechanical engineering, University of Washington, the process of gaging cylindrical tanks involved either a long and involved calculation, or the use of water. To preserve the accuracy of the chart, it is adapted to magazine publication, with permission of the University's Engineering Experiment Station, Seattle, Wash., by its division into three sections.

EVOLVED at the request of manufacturers and users of tanks who wished to gage their tanks without the use of water and without involved calculations, the chart presented in this article facilitates the gaging of *any cylindrical tank*, horizontal, spherical, or vertical, equipped with any of the different types of heads shown in Fig. 1.

Heads curves found in the chart are based on the most commonly used heads. The two ASME heads curves were derived graphically, the remainder, mathematically. For one of the ASME heads curves, the radius of the dish is equal to the diameter of the tank; for the other, the radius of the dish is 0.9 of the diameter of the tank. The ellipsoidal heads curve is based on the customary axis ratio of 2 to 1, and any other axis ratio would give a curve directly proportional thereto.

Horizontal Tanks

The chart gives direct readings for horizontal tanks from 5 ft to 10 ft in diameter and up to 20 ft long, and with any depth of contents from empty to full.

Smaller horizontal tanks are gaged by assuming that their dimensions and their depth of contents are doubled. The actual volume of contents will be one-eighth that of the chart reading.

Larger horizontal tanks are gaged by assuming that their dimensions and their depth of contents are halved. The actual volume of contents will be eight times that of the chart reading.

Horizontal tanks whose diameters fall within the range of the chart but whose lengths are greater are gaged as follows: First, find the contents of the heads. Second, assuming the cylindrical part to be only one-half, one-third, or one-quarter its actual length, find its contents. Double, triple, or quadruple this reading and add it to the contents of the heads.

Horizontal tanks, installed with a slight slope, can be gaged fairly accurately at mid-length unless they are nearly empty or nearly full.

Spherical Tanks

Spherical tanks are equivalent to two hemispherical heads and therefore can be gaged either directly or by size proportioning.

Vertical Tanks

Vertical tanks with flat bottoms are equivalent to full cylindrical tanks of proper length and are therefore easily gaged.

Hemispherical and spherical bottoms of vertical tanks are gaged by considering them as partly filled spheres. (Radius of hemispherical bottom equals radius of tank; radius of spherical bottom equals diameter of tank.)

ASME bottoms of vertical tanks are gaged by considering them as spherical ones (with radius of dish equal to the tank diameter or 0.9 thereof) within 10% of their total depth. The upper 10% of the bottom is then considered an extension of the cylinder.

Ellipsoidal bottoms (with axis ratio of 2 to 1) of vertical tanks are gaged by doubling their depth of contents and then taking half the corresponding volume of contents of a hemispherical bottom.

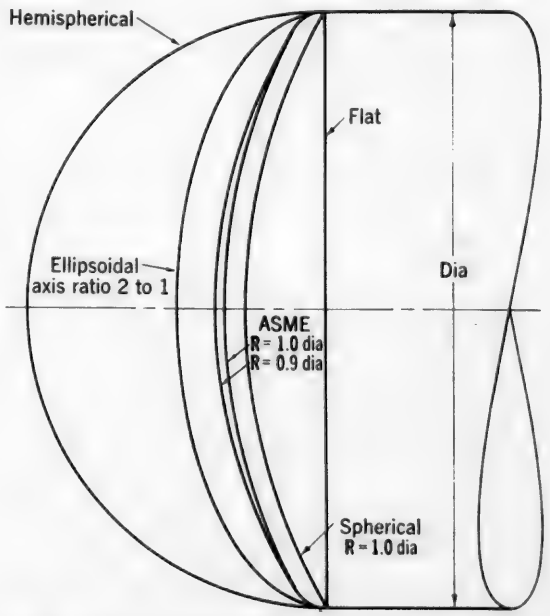


Fig. 1. Types of tank heads covered by chart.

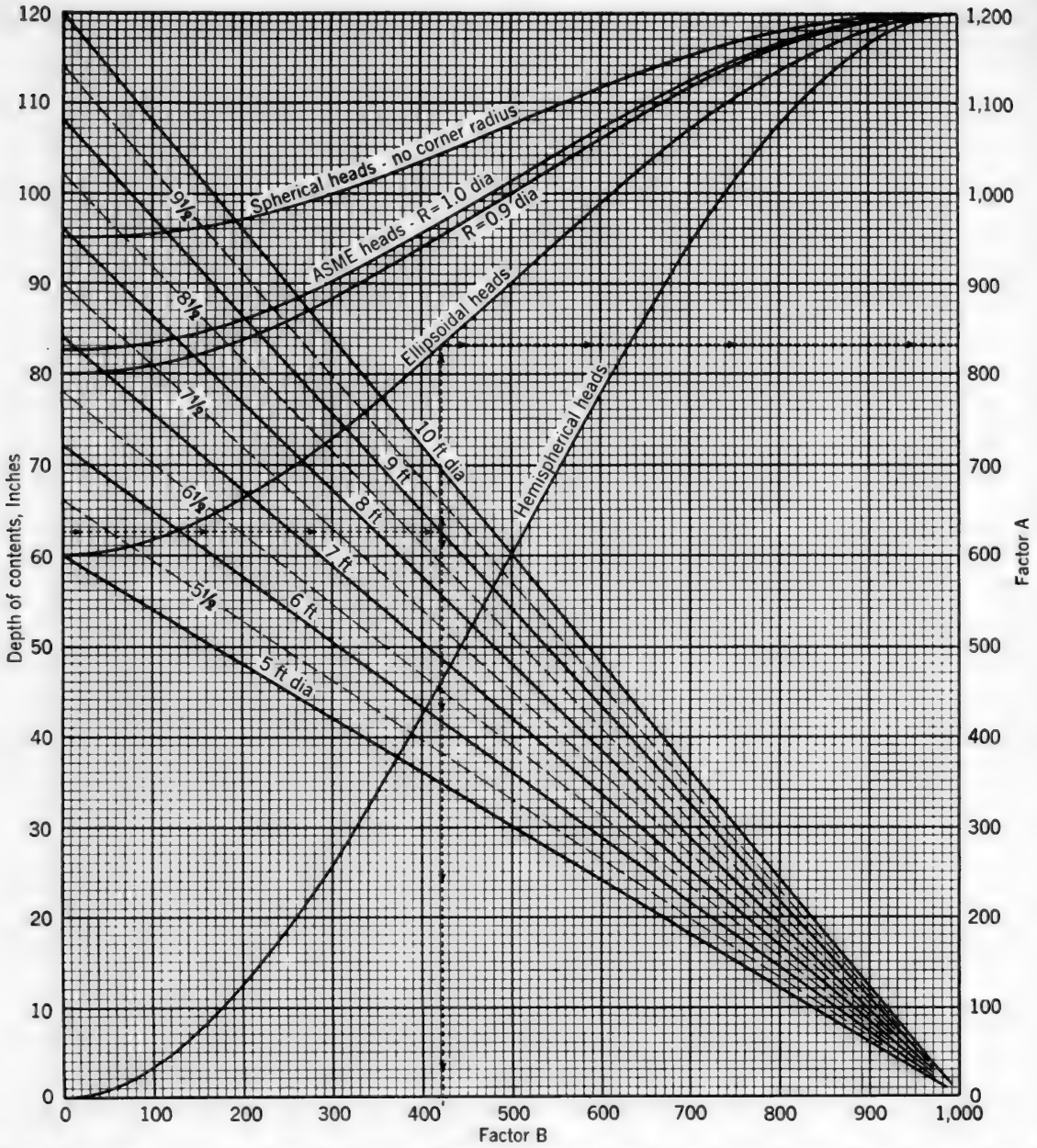


Fig. 2. All gaging problems start on left vertical depth-of-contents scale. Read out Factor *A* and proceed to Fig. 3, then read out Factor *B* and proceed to Fig. 4.

EXAMPLES

Horizontal Tanks

A horizontal cylindrical tank with ellipsoidal heads of 2 to 1 axis ratio is 9 ft in diameter, 16 ft long, and has a depth of contents of 62½ inches.

Contents of Heads—From the 62½-inch depth-of-contents point at left of Fig. 2, follow dashed line horizontally to the 9-ft diameter line, then vertically to the ellipsoidal-heads curve, then horizontally. Read Factor $A = 831$.

Enter Factor A at left in Fig. 3 and go horizontally to the 9-ft diameter line, then down. Read contents of both heads = 880 gal.

Contents of Cylinder—From the 62½-inch depth-of-contents point at the left of Fig. 2, follow dashed line horizontally to the 9-ft diameter line, then down to read Factor $B = 422$.

Enter Factor B at top of Fig. 4, and go downward to cylinder line, then horizontally to 9-ft diameter line, upward to 16-ft length-of-cylinder line, and finally horizontally to the right to read contents of cylinder = 4560 gal.

Contents of Tank—The volume of the contents of the tank is the sum of contents of cylinder and heads, or $880 + 4560 = 5440$ gal.

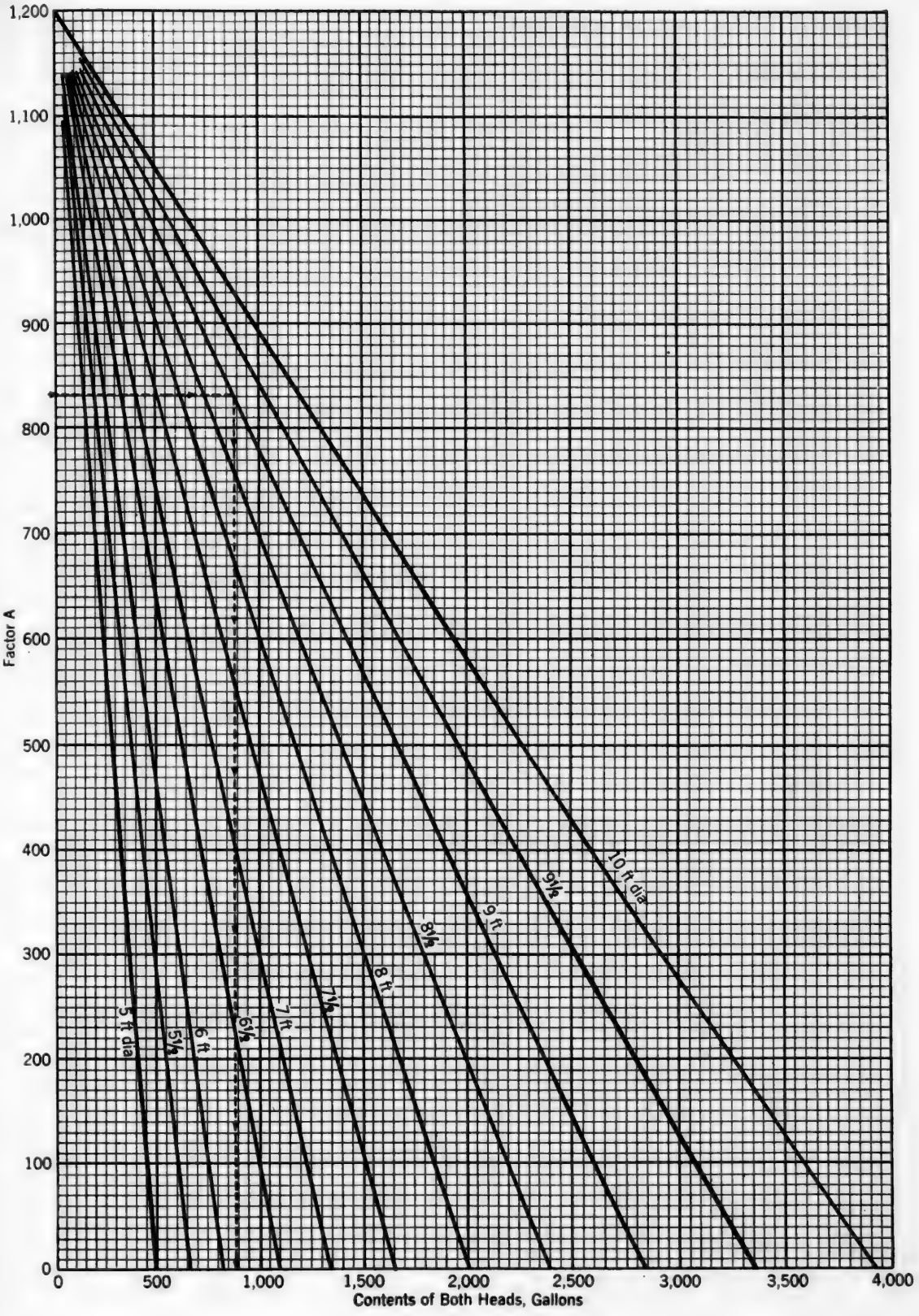


Fig. 3. This portion of the gaging chart gives the contents of *both* heads. Enter Factor **A** from Fig. 2 on left vertical scale. Read out contents of both heads on bottom scale. Figure 4 gives the contents of the cylindrical portion of the tank to be gaged. To obtain contents of entire tank (both heads plus cylindrical portion) add gallons obtained from Fig. 3 to gallons obtained from Fig. 4.

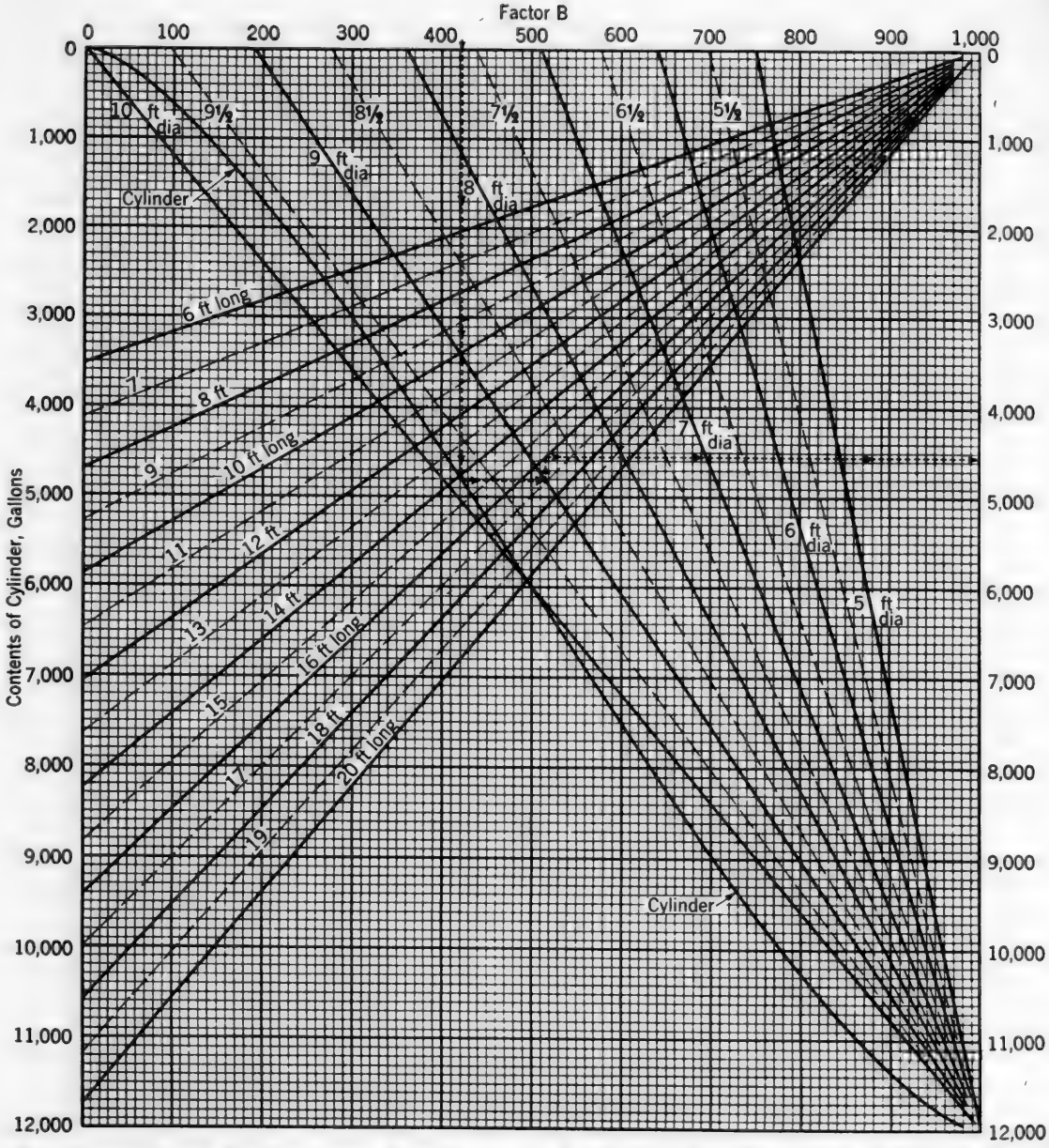


Fig. 4. Enter Factor *B* from Fig. 2 at top and read out contents of cylinder on either right or left vertical scales. Add to contents of both heads from Fig. 3 to obtain contents of tank.

A similar tank, 4½ ft in diameter and 8 ft long, having a depth of contents of 31¼ inches, would have a volume of contents of 5440 ÷ 8 = 680 gal.

A similar tank 18 ft in diameter and 32 ft long, having a depth of contents of 125 inches, would have a volume of contents of 5440 × 8 = 43520 gal.

A similar tank 9 ft in diameter and 64 ft long, having a depth of contents of 62½ inches, would have a volume of contents of 880 + 4(4560) = 19,120 gal.

The contents of nearly all ASME heads can be gaged by means of the two curves representing this type of head, either directly or by interpolation.

Spherical Tanks

A spherical tank 36 ft in diameter, having a depth of contents of 250 inches, would be gaged as follows: Consider a tank one-quarter (½ × ½) the size, i.e., with 9-ft diameter and depth of contents of 62½ inches. Entering Fig. 2, as before, and going horizontally to the 9-ft diameter line, then down to the hemispherical heads curve and horizontally to the right, read Factor *A* = 460. Entering Factor *A* at the left of Fig. 3, and proceeding horizontally to the 9-ft diameter line, then down, read 1760 for contents of both heads in gallons. Multiply the answer by the number eight, twice (because tank dimensions were halved twice) to get 112,600 gal.

Vertical Tanks

A vertical tank 9 ft in diameter with ellipsoidal bottom, having a depth of contents of 22 inches, would be gaged as follows: 2 × 22 inches = 44 inches, the corresponding volume of contents of a hemispherical bottom is found to be 1040 gal; and, 1040/2 = 520 gal.

QUANTITY OF HEAT IN FLASH STEAM

High Pressure System			Pressure in Low Pressure System, Lb. per Sq. In. Abs.										
Sat. Pressure Lb. per Sq. In. Abs.	Saturation Temperature, Deg. F.	Enthalpy of Sat. Liquid, Btu per Lb.	1	5	10	14.7	20	25	30	35	40	45	50
			Total Heat in Flash Steam, Btu per Lb. of H.P. Condensate										
5	162.2	130.1	60.4	—	—	—	—	—	—	—	—	—	—
10	193.2	161.2	91.5	31.1	—	—	—	—	—	—	—	—	—
14.7	212.0	180.1	110.4	50.0	18.9	—	—	—	—	—	—	—	—
20	228.0	196.2	126.5	66.1	35.0	16.1	—	—	—	—	—	—	—
25	240.1	208.4	138.7	78.3	47.2	28.3	12.2	—	—	—	—	—	—
30	250.3	218.8	149.1	88.7	57.6	38.7	22.6	10.4	—	—	—	—	—
35	259.3	227.9	158.2	97.8	66.7	47.8	31.7	19.5	9.1	—	—	—	—
40	267.3	236.0	166.3	105.9	74.8	55.9	39.8	27.6	17.2	8.1	—	—	—
45	274.4	243.4	173.7	113.3	82.2	63.3	47.2	35.0	24.6	15.5	7.4	—	—
50	281.0	250.1	180.4	120.0	88.9	70.0	53.9	41.7	31.3	22.2	12.9	6.2	—
55	287.1	256.3	186.6	126.2	95.1	76.2	60.1	47.9	37.5	28.4	20.3	12.9	6.2
60	292.7	262.1	192.4	132.0	100.9	82.0	65.9	53.7	43.3	34.2	26.1	18.7	12.0
65	298.0	267.5	197.8	137.4	106.3	87.4	71.3	59.1	48.7	39.6	31.5	24.1	17.4
70	302.9	272.6	202.9	142.5	111.4	92.5	76.4	64.2	53.8	44.7	36.6	29.2	22.5
75	307.6	277.4	207.7	147.3	116.2	97.3	81.2	69.0	58.6	49.5	41.4	34.0	27.3
80	312.0	282.0	212.3	151.9	120.8	101.9	85.8	73.6	63.2	54.1	46.0	38.6	31.9
85	316.3	286.4	216.7	156.3	125.2	106.3	90.2	78.0	67.6	58.5	50.4	43.0	36.3
90	320.3	290.6	220.9	160.5	129.4	110.5	94.4	82.2	71.8	62.7	54.6	47.2	40.5
95	324.1	294.6	224.9	164.5	133.4	114.5	98.4	86.2	75.8	66.7	58.6	51.2	44.5
100	327.8	298.4	228.7	168.3	137.2	118.3	102.2	90.0	79.6	70.5	62.4	55.0	48.3
110	334.8	305.7	236.0	175.6	144.5	125.6	109.5	97.3	86.9	77.8	69.7	62.3	55.6
120	341.3	312.4	242.7	182.3	151.2	132.3	116.2	104.0	93.6	84.5	76.4	69.0	62.3
130	347.3	318.8	249.1	188.7	157.6	138.7	122.6	110.4	100.0	90.9	82.8	75.4	68.7
140	353.0	324.8	255.1	194.7	163.6	144.7	128.6	116.4	106.0	96.9	88.8	81.4	74.7
150	358.4	330.5	260.8	200.4	169.3	150.4	134.3	122.1	111.7	102.6	94.5	87.1	80.4
160	363.5	335.9	266.2	205.8	174.7	155.8	139.7	127.5	117.1	108.0	99.9	92.5	85.8
170	368.4	341.1	271.4	211.0	179.8	161.0	144.9	132.7	122.3	113.2	105.1	97.7	91.0
180	373.1	346.0	276.3	215.9	184.8	165.9	149.8	137.6	127.2	118.1	110.0	102.6	95.9
190	377.5	350.8	281.1	220.7	189.6	170.7	154.6	142.4	132.0	122.9	114.8	107.4	100.7
200	381.8	355.4	285.7	225.3	194.2	175.3	159.2	147.0	136.6	127.5	119.4	112.0	105.3
225	391.8	366.1	296.4	236.0	204.9	186.0	169.9	157.7	147.3	138.2	130.1	122.7	116.0
250	401.0	376.0	306.3	245.9	214.8	195.9	179.8	167.6	157.2	148.1	140.0	132.6	125.9
275	409.4	385.2	315.5	255.1	224.0	205.1	189.0	176.8	166.4	157.3	149.2	141.8	135.1
300	417.3	393.8	324.1	263.7	232.6	213.7	197.6	185.4	175.0	165.9	157.8	150.4	143.7
350	431.7	409.7	340.0	279.6	248.5	229.6	213.5	201.3	190.9	181.8	173.7	166.3	159.6
400	444.6	424.0	354.3	293.9	262.8	243.9	227.8	215.6	205.2	196.1	188.0	180.6	173.9
450	456.3	437.2	367.5	307.1	276.0	257.1	241.0	228.8	218.4	209.3	201.2	193.8	187.1
500	467.0	449.4	379.7	319.3	288.1	269.3	253.2	241.0	230.6	221.5	213.4	206.0	199.3
1000	544.6	542.4	472.7	412.3	381.2	362.3	346.2	334.0	323.6	314.5	306.4	299.0	292.3

High Pressure System			Pressure in Low Pressure System, Lb. per Sq. In. Abs.										
Sat. Pressure, Lb. per Sq. In. Abs.	Saturation Temperature, Deg. F.	Enthalpy of Sat. Vapor, Btu per Lb.	55	60	65	70	75	80	85	90	95	100	110
			Total Heat in Flash Steam, Btu per Lb. of H.P. Condensate										
60	292.7	915.5	5.8	—	—	—	—	—	—	—	—	—	—
65	298.0	911.6	11.2	5.4	—	—	—	—	—	—	—	—	—
70	302.9	907.9	16.3	10.5	5 1	--	—	—	—	—	—	—	—
75	307.6	904.5	21 1	15.3	9.9	4.8	—	—	—	—	—	—	—
80	312 0	901 1	25.7	19.9	14.5	9.4	4.8	—	—	—	—	—	—
85	316.3	897 8	30.1	24.3	18.9	13.8	9.0	4 4	—	—	—	—	—
90	320.3	894 7	34.3	28 5	23 1	18.0	13.2	8.6	4.2	—	—	—	—
95	324.1	891.7	38 3	32.5	27.1	22.0	17.2	12.6	8 2	4 0	—	—	—
100	327.8	888.8	42.1	36.3	30.9	25.8	21.0	16.4	12.0	7.8	3.8	—	—
110	334.8	883 2	49.4	43.6	38.2	33.1	28.3	23.7	19.3	15.1	11.1	7 3	—
120	341.3	877.9	56.1	50.3	44.9	39 8	35.0	30.4	26.0	21.8	17.8	14 0	6 7
130	347.3	872 9	62 5	56 7	51 3	46 2	41.4	36.8	32 4	28 2	24.2	20 4	13.1
140	353 0	868.2	68.5	62 7	57.3	52 2	47.4	42.8	38 4	34.2	30.2	26.4	19 1
150	358.4	863.6	74 2	68 4	63.0	57.9	53.1	48.5	44.1	39.9	35 9	32 1	24.8
160	363.5	859.2	79.6	73.8	68.4	63.3	58.5	53.9	49 5	45.3	41 3	37 5	30 2
170	368.4	854.9	84 8	79.0	73.6	68 5	63.7	59.1	54.7	50 5	46 5	42 7	35.4
180	373.1	850 8	89 7	83.9	78.5	73.4	68.6	64.0	59.6	55.4	51.4	47 6	40.3
190	377.5	846 8	94.5	88.7	83.3	78.2	73 4	68 8	64.4	60 2	56 2	52 4	44.1
200	381.8	843.0	99.1	93.3	87.9	82.8	78.0	73 4	69 0	64 8	60 8	57 0	49.7
225	391.8	833.8	109.8	104.0	98.6	93.5	88.7	84 1	79 7	75 5	71 5	67 7	60.4
250	401.0	825.1	119.7	113.9	108.5	103.4	98.6	94.0	89.6	85 4	81 4	77 6	70 3
275	409.4	816 9	128 9	123.1	117.7	112.6	107.8	103 2	98.8	94 6	90 6	86.8	79.5
300	417.3	809 0	137 5	131 7	126.3	121.2	116.4	111.8	107 4	103.2	99 2	95 4	88.1
350	431.7	794.2	153.4	147.6	142.2	137 1	132.3	127.7	123 3	119 1	115 1	111 3	104 0
400	444.6	780.5	167.7	161.9	156.5	151.4	146.6	142.0	137 6	133 4	129 4	125 6	118.3
450	456.3	767.4	180.9	175.1	169.7	164.6	159.8	155.2	150.8	146.6	142.6	138.8	131.5
500	467.0	755.0	193.1	187.3	181.9	176.8	172.0	167.4	163.0	158.8	154.8	151.0	143.7
1000	544.6	649.4	286.1	280.3	274.9	269.8	265.0	260.4	256.0	251.8	247.8	244.0	236.7

Where high temperature condensate or continuous boiler blowdown is available, there may be opportunities to make controlled use of flash steam. The energy in water at high pressure and near saturation temperature produces flash steam instantaneously when pressure is reduced below saturation. The amount of steam so produced depends on the enthalpy of water and steam at each temperature and pressure. Since enthalpy is not a straight line function of either temperature or pressure, there is no convenient designation of the amount of steam produced per unit of pressure drop. Calculations must be made from data pertaining to actual conditions.

As an example, if saturated water at 70 psia and 303 deg F with enthalpy of 272.6 Btu per lb is discharged into a tank maintained at 20 psia, it must immediately assume the saturation conditions of the lower pressure, 228 deg and 196.2 Btu per lb.

The purpose of the accompanying table is to simplify the foregoing calculation. Enter the table at 70 in the left hand column and move to the right under the column headed 20 and find 76.4 as the Btu per pound of high pressure condensate.

AIR CONDITIONING, HEATING AND VENTILATING'S Reference Section

REFRIGERANTS

W. A. PENNINGTON
Professor, Department of Chemical Engineering, University of Maryland

Although a refrigerant is the basic element of a refrigeration system, not too many engineers have a clear understanding of the various refrigerants commonly used, how one differs from the other, desirable properties in refrigerants and refrigerant mixtures. Here in one article is a wealth of information that should be valuable to the engineer engaged in air conditioning and refrigeration work.

AMONG the various ways of producing refrigeration, fluids called refrigerants, that act as working media to transfer heat from one particular spot where "cold" is desired to another place where the heat can be dissipated, are used. A simple refrigeration system is shown schematically in Fig. 1. These same fluids are employed in heat pumps which are similar systems, the difference being that heat is "picked up" from a convenient source, such as outside air, a stream or body of water, or the ground and delivered to a spot where heat is desired. The former condition exists for a household refrigerator, a food freezer, a room air conditioner, or a refrigerated display case; the latter, for a heat pump used to take heat from a source at low temperature and deliver it to a desired place at a higher temperature. A house can be heated by pumping heat from the air outside, even though it is cold, to the air inside. A combination system which can be made to act as a heat pump in cold weather and as an air conditioning unit in hot weather is being sold; the evaporator for the summer condition becomes the condenser in the winter through the use of a reversing valve as illustrated in Fig. 2.

To get the proper perspective on the role played by refrigerants, it will be well to take a cursory glance at some different means of producing refrigeration, which are as follows: (1) Demagnetization of a solid; (2) passage of an electric current through two solid junctions formed by two metals; (3) desorption of a gas; (4) expanding a gas to take advantage of the Joule-Thomson effect; (5) expanding a compressed gas so that it does external work; (6) boiling of a liquid and compressing the vapor to a condensate at a higher temperature; and (7) boiling of a liquid with the absorption of the vapor in a solution.

The last five means of refrigeration use fluids that are called refrigerants. Attention in this article will be devoted primarily to the last three and, more specially, to the last two because they are used much more than the others.

In passing, it might be well to mention that the means of creating refrigeration by conducting an electric current through two junctions formed by two metals is showing much promise with the advent of semiconductors. Up until recent years, this method did not offer much encouragement because the heat produced at one junction would be conducted along the metal to nullify the cooling produced at the other junction. With the discovery of semiconductors, which include substances that are good conductors of electricity but poor conductors of heat, much more attention is being given to the production of practicable refrigeration systems using this principle.

Methods 4 and 5 are used for reaching very low

William A. Pennington received his undergraduate training at Union University. Upon graduation, he served as high school principal, Spring Hill High School, Trenton, Tenn., from which position he went to Iowa State College for his doctorate in chemistry. It was at the Armco Steel Company, that he started the work on decarburization of steel that was recognized later with the presentation of the Howe Medal. This work was completed at Mellon Institute where he was an Industrial Fellow in charge of the Foundry Practice Fellowship. While in the position of Chief Chemist and Metallurgist at the Carrier Corporation, he became one of the co-inventors of Refrigerant 500, the first and only commercial azeotropic refrigerant used today. At present he is in charge of Metallurgy in the Department of Chemical Engineering at the University of Maryland. In addition, he is directing research on refrigerants in the same department. He is the holder of several patents and the author of many technical papers.

temperatures such as in the production of liquid air, nitrogen, or oxygen.

It will be noted in all cases that one does not just produce cold. In reality, "cold" and "hot" are produced simultaneously. Heat is merely pumped from one energy elevation to a higher level much as water is pumped out of the ground to ground level or even to the top of a skyscraper.

This principle even applies for the old fashioned ice box where water-ice is used for refrigeration. It is true that the ice only cools in this application, but it obtained its cooling power, when manufactured, from a refrigeration system where heat was pumped out of liquid water, at 32 deg F to solidify the water, and rejected to cooling water at some elevated temperature, say 100 deg.

One often thinks of a refrigerant as being something which is cold. Not necessarily; it is a fluid that can either be cold or can be made cold with forced boiling. An examination of Fig. 3 will reveal the nature of some refrigerants that depend upon vaporization for their effectiveness. These three refrigerants are dichlorodifluoromethane (CCl_2F_2), trichlorofluoromethane (CCl_3F), and water (H_2O). In all cases shown, the containers are to be regarded as located in air at 77 deg F. Where the valves are closed (*a*, *d*, *g*), the refrigerants will be inactive and all will be at room temperature (77 deg). However, the pressures will be different because of the difference in nature of the refrigerants.

Suppose that the valves are opened so as to make communication with the outside air, CCl_2F_2 vapor in *b* will flow out pushing the air back and a temperature of —21.7 deg will be established and maintained until the liquid refrigerant is exhausted. In *e*, CCl_3F will boil*, giving a temperature of 74.7 deg. Water (in *h*) will not boil because it does not have the power to push back the air. When the valve is opened air will flow into the container and this will bring the total pressure up to 14.7 psia.

A compressor is being used in *c*, *f*, and *i* to compress the vapor to some pressure exceeding that indicated in the containers and adjustments made so as to maintain a temperature of 40 deg. All three refrigerants will be boiling and producing "cold" by virtue of the absorption of heat by the molecules as they change from the liquid to the vapor state.

With this elementary view of refrigerants it might be well as a matter of appreciation to regard the air conditioning or refrigeration system of the human body without which neither the human nor the body would exist.

It has been estimated that a normal man weighing 175 lb will evaporate about 3 lb water a day in regulating his temperature at the nominal value of 98.6 deg F. Since water is cheap it does not matter that it completely escapes the domain of the individual. It will still be condensed into clouds and come back to human level as rain where it can be put back in the evaporator for further refrigeration. Of course, the chance of getting back many of the molecules that were previously used by the same person is slight indeed. In a year's time this man will evaporate about 1100 lb water.

Let us suppose that, instead of using water, which is cheap, CCl_2F_2 had to be bought at $0.40 per lb for regulating the body temperature, the refrigerant still being allowed to escape. Because of the difference in the latent heat of vaporization of the two refrigerants, 20,350 lb CCl_2F_2 would be required to do the refrigeration of 1100 lb water. The annual cost then would be a little more than $8,000. If it is assumed that there are 2,500,000,000 people in the world and the average amount of water evaporated per person is 2 lb, then a thermodynamically equivalent amount of CCl_2F_2 would cost almost 4 trillion dollars per year for the body-air conditioning of all the people in the world. Not only does water play an important part in natural refrigeration, it also has its place in man-made machines where it is used over and over again.

Types of Refrigerants

Until the early nineteen thirties the principal refrigerants were ammonia, carbon dioxide, sulfur dioxide, methyl chloride, and the hydrocarbons. Thermodynamically they are all good refrigerants for commercial use in reciprocating machines, except carbon dioxide; its critical temperature is too low although it has been employed rather extensively. As far as chemical properties are concerned they all fall far short. Ammonia, methyl chloride and the hydrocarbons will burn and, under cer-

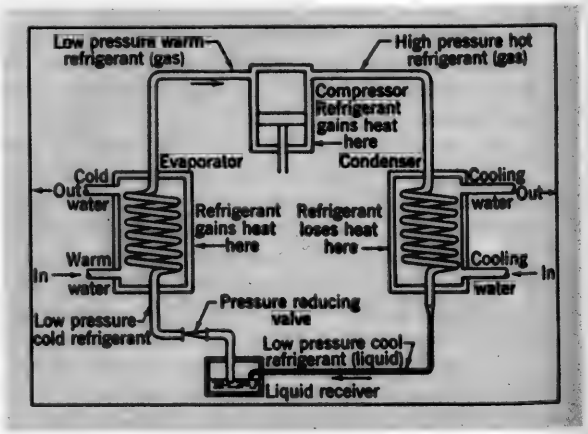


Fig. 1. Basic refrigeration cycle, in this case as applied to chilling water.

* Actually the boiling point of CCl_3F is so close to 77 deg that it may not give a boiling action. It still will exist here at its normal boiling temperature keeping itself cool by a "lifting off" of a layer of molecules at the surface as is required.

tain conditions, where mixed with air, will explode. They are all toxic. Methyl chloride will react directly with aluminum to produce aluminum trimethyl, a gas which will catch fire spontaneously in the presence of air.

With the development of centrifugal refrigeration by W. H. Carrier about 1920 there was a need for a high molecular weight compound which would have a normal boiling near room temperature. Dilene ($C_2H_2Cl_2$) was obtained from a German firm in 1921. Methylene chloride (CH_2Cl_2) came into use in 1926 giving approximately twice the refrigeration capacity for a given impeller at the same speed, although twice the power was required in comparison.

In 1930, Midgley presented his paper on Organic Fluorides as Refrigerants before the American Chemical Society. Carrier was interested in the subject and immediately began testing "Freon-11" (CCl_3F) with a normal boiling point of 74.7 deg. It was a much improved refrigerant over methylene chloride and was soon to attain considerable popularity. Today it is used extensively in centrifugal machines with refrigeration capacities from 100 tons[1] upward. More recently the compound CCl_2FCClF_2 with a boiling point of 117.6 deg is coming into use making lower capacity machines practicable.

The first commercial azeotropic refrigerant, Carrene 7, containing 26.2% CH_3CHF_2 and 73.8% CCl_2F_2, was put on a restricted market in 1950 to be used in special situations to get about 20% more refrigeration capacity than CCl_2F_2 with a given compressor running at the same speed. As far as is known, it is the only commercial azeotropic* refrigerant today.

The halocarbons are so much safer to use than ammonia, sulfur dioxide, and the other refrigerants used before 1930 that they have almost completely replaced the less desirable refrigerants.

There are so many names bearing close resemblance to each other, such as trichlorofluoromethane and chlorotrifluoromethane, that it becomes imperative to have a simple number designation system. The first refrigerant mentioned immediately above has a normal boiling point of 74.7 deg; the other, —73.6 deg, a difference of about 158 deg—quite a difference and yet one name may be confused with the other.

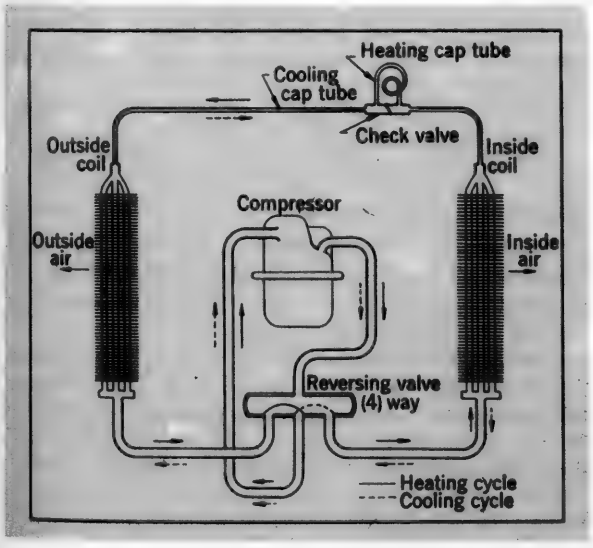


Fig. 2. Basic circuit of air-to-air heat pump. Courtesy T. G. Crider, Hupp Corporation.

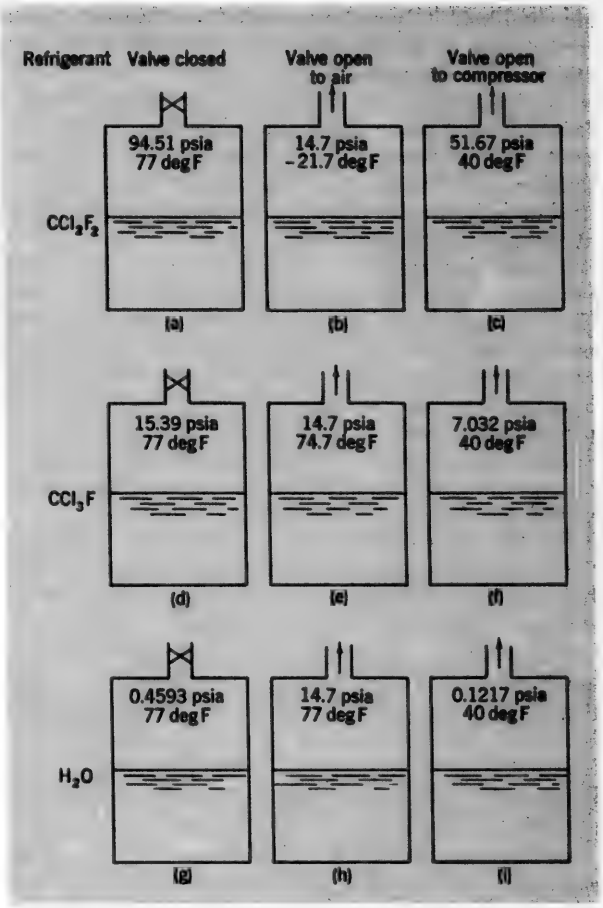


Fig. 3. Temperatures of some refrigerants under various conditions, the ambient temperature being 77 deg. F.

Designating System

The E. I. du Pont de Nemours Company has given its number system[2] to the industry. This "Freon" system of numbers originally applied to saturated halocarbons and was later extended to include unsaturated halocarbons.

For the saturated halocarbons, there are two or three digits in the number. If there are two digits, the number should be regarded as having three digits, the first being zero. One may obtain the formula by adding "one" to the first digit to get the number of carbon atoms, subtracting "one" from the second digit to get the number of hydrogen atoms, and neither adding or subtracting anything from the third digit to get the number of fluorine atoms. Any valencies not satisfied by hydrogen or fluorine will be filled with chlorine atoms.

While the same numbers are now used the word "Freon" being a trade name cannot be used to apply to a material if it is not made by du Pont. The generic term adopted by the American Society of Refrigerating Engineers is "Refrigerant." Under the present ASRE standard on refrigerant numbering CCl_2F_2 is Refrigerant 12 or

[1] A ton of refrigeration is 200 Btu/min, being so called because it is the rate of heat absorption by a ton of ice melting in a day.
[2] ASRE Standard 34, *Refrigerating Engineering*, 65, No. 2, 49-51 (1957).

* See page 81 for an explanation of azeotropic refrigerant.

simply 12, if it is understood that a refrigerant is intended. One is not permitted to abbreviate to R12 and still abide by Standard 34.

Refrigerant 12 is in reality, then, "Refrigerant 012." It is somewhat of a mystery as to why one must add, subtract, and do nothing, as the case may be, to get the number of different atoms. The number "102" could be used to designate directly one carbon atom, zero hydrogen atoms, and two fluorine atoms.

The number system for halocarbons was not offered until it was extended to cover many other refrigerants. The extended system covers saturated halocarbons with numbers up to, but not including, 500; the five hundred series is for azeotropes; the six hundred series certain hydrocarbons with oxygen, sulfur, and nitrogen compounds; the seven hundred series for inorganic compounds; the thousand series for unsaturated hydrocarbons, the last three digits having the same significance as with the saturated halocarbons.

For the seven hundred series, the last two digits give the molecular weight, water becoming Refrigerant 718. It is somewhat difficult to appreciate the substitution of the term "Refrigerant 718" for "water."

This pointless conformity to a system, where water is not water, is only part, a small part at that, of the price that has to be paid. The worst part is accepting Refrigerant 501 as the designation of an azeotropic mixture of Refrigerant 12 and Refrigerant 22 containing 25 wt. per-cent Refrigerant 12. This is not the azeotropic composition for the system, it is closer to 2% Refrigerant 12.

An objection can also be raised to assigning 502 to an azeotropic mixture of 22 and 115 especially when many other known azeotropes were ignored. They should have been ignored because they are not commercial; neither is the azeotrope of 22 and 115.

Refrigerant 500, the only known commercial azeotropic refrigerant, contains 26.2% of 152 and 73.8% of 12. It does not have two azeotropic competitors as might be inferred from the other designations. Commercially it is in a class by itself.

Desirable Properties in Refrigerants

Not only is it important to have good thermodynamic properties in a refrigerant, but it is also imperative to have certain desirable physical and chemical properties.

In the first place the liquid must have a fairly low freezing point so that solid will not be formed in the evaporator. Water, which is a good refrigerant, in many ways, cannot be employed to attain temperatures lower than 32 deg. The critical temperature should not be too low or otherwise the efficiency of operation will be extremely low. Carbon dioxide with a critical temperature of 87.8 deg gives poor performance for any ordinary refrigeration. Ammonia, on the other hand, with a critical temperature of 271.4 deg gives very satisfactory performance.

For a good many years nearly all refrigerants used were toxic, flammable, or explosive where mixed with the proper amount of air; some had all three disadvantages. Methyl chloride not only has these disadvantages, but reacts with aluminum to form aluminum trimethyl, a spontaneously combustible gas. Therefore it cannot be used in machines where it will come in contact with aluminum.

The halocarbon refrigerants have gone a long way toward replacing carbon dioxide, methyl chloride, sulfur dioxide, the hydrocarbons, methylene chloride, dielene, and, even ammonia, because many of them are nontoxic, nonflammable, and will not explode where mixed with air. Refrigerants 11, 12, 22, 113, 114, and 500 are the most important commercial refrigerants today, having these desirable properties.

The matter of flammability is not so important where the refrigerant is used in a place such as an oil refinery. Everything the plant makes is flammable, so that engineers would not be adding much to the hazards by using propane as a refrigerant. The importance of nonflammability for small units has been far overplayed. After all, gasoline is quite flammable, but plenty of it is used around every home.

Chemical stability is important in any refrigerant. If it decomposes one naturally has to be concerned about the products. There are so many stable refrigerants on the market that one does not need to take a chance with a questionable one.

Ammonia is quite stable except where used with a metal such as copper. Particularly in the presence of water, its corrosion rate on copper is very heavy. This has been learned through the years. However, the characteristics of ammonia are so well known that it can be used to a great advantage in some large commercial applications which operate under the direction of an engineer—to a great advantage because thermodynamically it is an excellent fluid to use in compression refrigeration.

In general, the molecular weight should be low for compression refrigeration and high for centrifugal refrigeration. One often sees a reference to the effect that the compression ratio should be low. On the contrary, it should be high. It is the molar latent heat of vaporization that produces the refrigeration. The greater the compression ratio, the greater will be the molar latent heat and the greater will be the percentage of the latent heat used to cool the work.

The molar specific heat of the liquid should be low. Otherwise, too much cooling is required for the hot liquid entering the evaporator. The specific heat of the vapor should be high, but only if this does not automatically call for high specific heat of the liquid. Of the two, that of the liquid is more important. Since they go hand in hand, the specific heats should be low.

There are other properties such as water solubility, viscosity, and heat transfer that have their importance even though the range on each can be rather broad.

Ideal Refrigeration Cycle

Through a consideration of the second law of thermodynamics one may arrive at the ideal refrigeration cycle, so called because it is reversible and gets the maximum amount of cooling for work expended.

From Carnot's cycle, which is described in any text on thermodynamics, it may be found that a heat engine, taking in heat Q_2 at a temperature T_2 and rejecting Q_1 at T_1, will show the following for the relation of work W done because of the introduction of the heat Q_2:

$$\frac{W}{Q_2} = \frac{T_2 - T_1}{T_2}, \qquad (1)$$

the temperatures being absolute.

If the cycle be reversed as in refrigeration, interest focuses on the amount of heat Q_1 "picked up" at T_1. Since W in Equation (1) is $Q_2 - Q_1$, by substitution and proper rearrangement, it may be shown that

$$\frac{Q_1}{W} = \frac{T_1}{T_2 - T_1}. \qquad (2)$$

The quotient Q_1/W is, of course, the ratio of the heat pumped out of the evaporator to the work required for the pumping. This quotient is called the coefficient of performance, *COP*, that of the Carnot's cycle being a maximum for a given temperature lift.

In an actual refrigeration cycle, reversibility does not exist and therefore there will be losses causing the *COP* to be less than that for the ideal cycle.

Standard Ton Conditions

In order to compare refrigerants as to performance, either the operating conditions should be the same as nearly as possible or the same machine should be used and let the conditions change as they will. In most cases the former is used.

In other words, it is assumed that a different machine is designed for each refrigerant such that the same evaporator temperature will be maintained; likewise, the same condensing temperature will be maintained. Once these conditions are set, the superheat temperature and a good many other properties are fixed depending upon the nature of the two refrigerants.

Before discussing further standard conditions, it becomes necessary to define the term "ton of refrigeration." It is the removal in the evaporator of 200 Btu per min, the concept being derived from the fact that this is the rate that heat must be removed from 32 deg liquid water to produce one ton of ice at 32 deg in 24 hours.

Where the evaporator temperature is held at 5 deg and the condenser at 86 deg, the condition is called the "standard ton." Ice could well be made where such conditions exist. It is significant that, for most refrigerants, one horsepower will produce about one ton of refrigeration under these conditions.

Simple Refrigeration Cycle

A realistic refrigeration cycle is somewhat complicated and it is rather difficult to fill in all the details for a complete understanding of a cycle for a given refrigerant.

In trying to get a general understanding of the phenomenon, it pays to make a simple model and see how well it fits the engineering facts. In other words, one should predict from the simple model and make the proof with a refrigeration calorimeter.

To set up a simple model let us first assume that the cycle is started at A in Fig. 4 with an isentropic compression to B. This assumption is tantamount to saying that no heat is exchanged between the compressor and the fluid. The gas at B will have a temperature at least as high as the condensing liquid, generally higher depending on the nature of the gas. For standard ton conditions Refrigerant 22 will be at 131 deg at B; Refrigerant 114, at 86 deg which is identical with the condensing temperature.

If there is superheat, as for 22, it will be rejected to the heat sink until the condensation temperature is reached, at which point, the latent heat of vaporization will likewise be rejected, resulting in condensation of the fluid. The condensation, the second step in the cycle, will give a great reduction in volume. As a matter of fact, the volume of the liquid is being neglected in order to build up the desired simple model. The condensed liquid is represented by C where the pressure is p_2 and the temperature t_2. The third step involves the transfer of the liquid through an expansion valve or capillary tube where it is cooled to t_1 and p_1 at D. This cooling is effected at the expense of some of the latent heat of vaporization. The fourth step, going from D to A, involves the boiling of the refrigerant to get again vapor at A thus completing the cycle.

The work done in the cycle is represented by the sum of Areas I and II which can be evaluated in two fairly simple ways.

In one method use can be made of the fact that the work of compression, $-\int pdv$, is the sum of I and IV, but IV is $-p_1(v_2 - v_1)$ and this must be subtracted in order to get Area I. The area of II is $-v_2(p_1 - p_2)$. The cyclic work then is

$$W = -\int_{v_1}^{v_2} pdv + p_1(v_2 - v_1) - v_2(p_1 - p_2) \qquad (3)$$

Each of the three terms can be evaluated, but the integration may require a disproportionate amount of time, depending on the degree of complication of the equation of state.

In the second method inasmuch as the volume is assumed to go to zero (neglecting the volume of the liquid), the area of I and II may be given as

$+\int_{p_1}^{p_2} vdp$. Hence, the cyclic work is

$$W = +\int_{p_1}^{p_2} vdp \qquad (4)$$

which is just as difficult to evaluate as the previous integral. Therefore, if one stopped at this point, there is little to choose between the two methods.

Since the compression process approaching a condition of constant entropy and, indeed, has been assumed to be isentropic it behooves us to examine the combined statements of the first and second law of thermodynamics involving the differential dS for entropy. These equations are

$$dE = TdS - pdv \qquad (5)$$

and

$$dH = TdS + vdp. \qquad (6)$$

For constant entropy,

$$dE = -pdv \text{ and} \qquad (7)$$

$$dH = vdp \qquad (8)$$

Enthalpy values are of greater significance generally in thermodynamic calculations involving refrigerants and

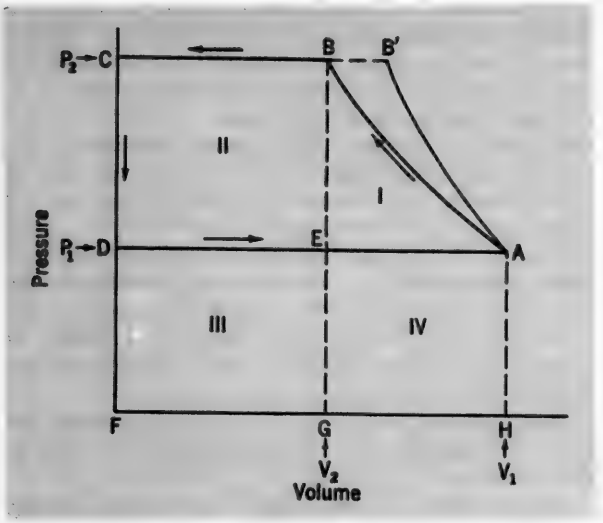


Fig. 4. Simple refrigeration thermodynamic cycle.

consequently are tabulated among the useful thermodynamic data. This fact leads to a preference for Equation (8). It is immediately obvious on combining Equations (4) and (8) that

$$W = H_2 - H_1. \qquad (9)$$

The change in enthalpy for the compression process is identical with the work for the entire cycle.

In evaluating the *COP* (Q_1/W) for a refrigerant one uses

$$\frac{Q_1}{W} = \frac{-(h_l)_{t_2} + (h_g)_{t_1}}{(h_g)_{t_3} - (h_g)_{t_1}}, \qquad (10)$$

where h, t, l, and g denote enthalpy, temperature, liquid, and gas, respectively. t_1, t_2, and t_3 are the evaporator, condenser, and discharge temperatures, respectively.

Q_1 is often referred to as the net refrigeration effect. In the case of Refrigerant 12 for the standard ton conditions, it is 50.036 Btu per lb and yet the latent heat of vaporization is 68.204 Btu per lb. This means that 26.64% of the latent heat cooling power must be used to cool the hot liquid refrigerant coming from the condenser. In seeking more desirable refrigerants, it certainly looks as though one should attempt to find one where the greatest percentage of the latent heat is used for useful cooling.

The concept of "latent heat efficiency" has been defined in the literature[3] as the fraction or percentage of the latent heat used to get useful cooling. On the percentage basis

$$L_v = \frac{100Q_1}{h_g - h_l}. \qquad (11)$$

Obviously if L_v is zero there can be no useful cooling whatsoever. In other words, all the latent heat cooling power is used to cool the refrigerant. This condition can be visualized where the evaporator is surrounded by a perfect insulator. If such a system is started, using Refrigerant 12, and the condenser maintained at 210 deg, the evaporator will be at −130 deg and dry. All the heat rejected at 210 deg is the heat of compression, none of it being net heat pumped from a level of −130 deg to a level of 210 deg. It would be impossible then to pump heat from −130.1 deg to heat a chemical solution to 210 deg using Refrigerant 12. Hypothetically it could be done from −129.9 deg but, of course, would be exceedingly inefficient.

Returning to the standard ton conditions where L_v for 12 is 73.36, one may surmise that some other or new refrigerant with a latent heat efficiency of say 80, will be more desirable. In general this is quite true, but one must be careful in coming to such a conclusion. This

TABLE I †—COMPARATIVE REFRIGERANT CHARACTERISTICS (Standard Ton)

Refrig. No.	Formula	Boiling Point	Compression Ratio	COP	Hp per Ton	Disch. Temp., Deg F
13B1	$CBrF_3$	−73.6	3.36	4.25	1.109	124
290	C_3H_8	−44.2	3.70	4.58	1.029	97
22	$CHClF_2$	−41.4	4.06	4.66	1.012	131
717	NH_3	−28.0	4.94	4.76	0.990	210
500	——	−28.0	4.12	4.61	1.023	105
12	CCl_2F_2	−21.7	4.07	4.70	1.003	100
40	CH_3Cl	−10.8	4.48	4.90	0.962	172
764	SO_2	14.0	5.63	4.87	0.968	191
600	n-C_4H_{10}	31.3	5.07	4.95	0.952	88
114	$CClF_2CClF_2$	38.4	5.42	4.64	1.016	86
21	$CHCl_2F$	48.0	5.96	5.05	0.933	142
11	CCl_3F	74.7	6.24	5.09	0.926	112
113	CCl_2FCClF_2	117.6	8.02	4.92	0.958	86

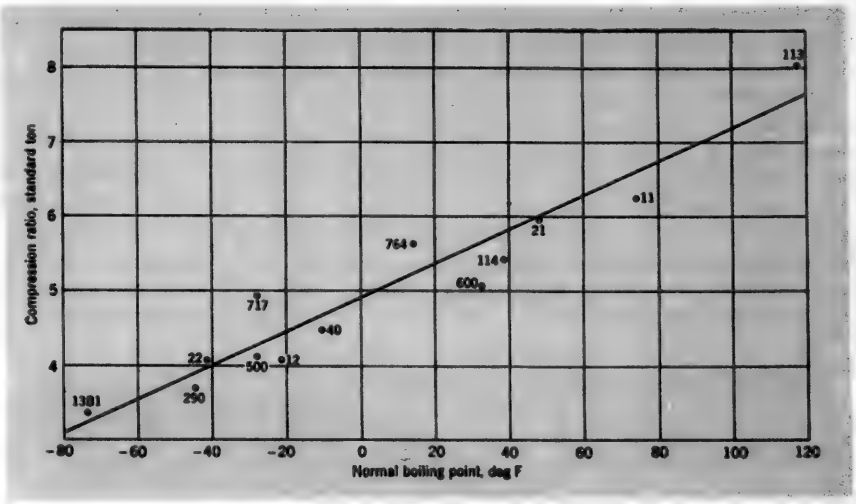
† Based on a table by Reed, *Air Conditioning and Refrigeration News* reproduced by permission

For a given refrigerant then, one may use a Mollier chart where pressure is plotted against enthalpy and go out along a constant entropy line to find H_2, having started at a point on the saturation curve giving H_1. The discharge temperature can also be read from the chart. Because the charts are difficult to read unless they are made very large, it is often desirable to make use of the tabular data and interpolate for a more precise value of the change in enthalpy and, hence, the work of the cycle.

It is abundantly clear now why the simple model is so important—it is so easy to get the work of the cycle from tabulated, thermodynamic data. Sight must not be lost of the fact that one does not only want something simple; he also wants something accurate. Calorimeter tests involving refrigerants in action have demonstrated that the simple model fits the real situation well enough to justify its use in comparing the merits of various refrigerants.

[3] Pennington—*World Refrig.*, *8*, 85 (1957).

Fig. 5. Effect of boiling point on the compression ratio of some refrigerants.



can be borne out through a speculation involving Refrigerant 12.

Carnot's cycle for the standard ton conditions gives

$$\frac{Q_1}{W} = \frac{T_1}{T_2 - T_1} = \frac{464.72}{81} = 5.737.$$

Calculations for Refrigerant 12 using Equation (10) give

$$Q_1/W = 4.70,$$

which means that if Q_1 is 200, W is 42.55, the work each minute in doing refrigeration at a capacity of one ton.

It has already been shown that L_v is 73.36 meaning that the 200 Btu could be boosted to 272.6 Btu if all the latent heat could be used. However, this could not be done unless the specific heat of the liquid is zero. While that of Refrigerant 12 is not zero, some other refrigerant might be found with a value nearer this limiting value. The limiting condition, even for the imagination, is zero so that the situation can be analyzed where the specific heat of Refrigerant 12 is regarded as zero. Assume that this has no other effect on the cycle in Fig. 4. In other words, the same work, 42.55 Btu, will now pump 272.6 Btu to the 86 deg level. Q_1/W will now be 6.407 which is considerably better than the ideal Carnot cycle. This is a gross violation of the second law of thermodynamics.

Since there is no question about the pressures or the beginning point *A* in Fig. 4, *B* must be shifted for the new situation. There must be more work to bring the *COP* down below 5.737 and, therefore, the sum of the areas of I and II must be increased as indicated by moving *B* to *B'*. The refrigerant would get hotter in the compression if the specific heat of the liquid were less. It naturally follows that the specific heat of the vapor would be less if that of the liquid were less.

The speculation indulged in the foregoing demonstrates that there is an advantage in having a low specific heat in the liquid. The lower the specific heat of the vapor the greater will be the discharge temperature for an otherwise constant set of conditions and, consequently, the more work will have to be done in the compression. The advantage of the low specific heat in the liquid outweighs the disadvantage of the low specific heat of vapor so that there is a net gain by having low specific heat in the liquid even though it is accompanied with a low specific heat in the vapor.

Again in considering the compression ratio and claims that a low ratio is desired, examine the situation quantitatively. The limiting ratio downward is unity, even

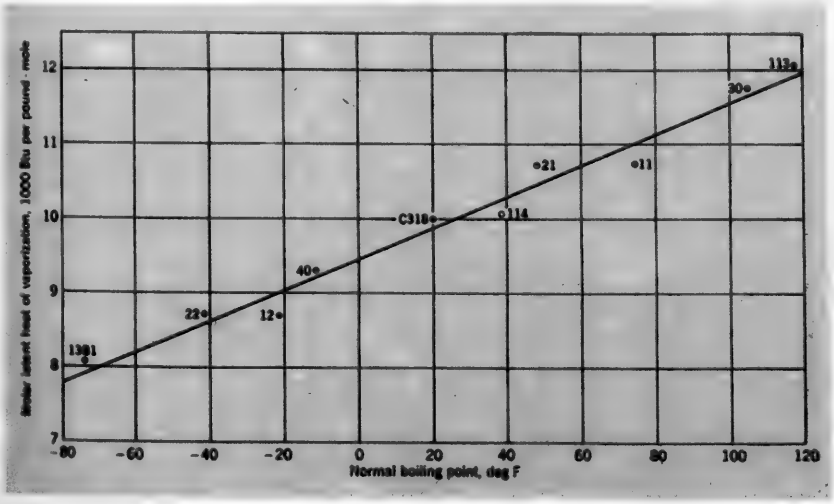


Fig. 6. Effect of boiling point on the molar latent heat of some refrigerants.

for the imagination. On examining Fig. 4, it is found that W is zero and, hence, Q_1/W is infinite, trampling the second law into oblivion, unless Q_1 is also zero. As long as Q_1/W is constant, it does not matter about the compression ratio for the same evaporator pressure and temperature it is true that more work will be done per stroke if the compression ratio is high, but so will more latent heat be involved (Clausius-Clapeyron). Perhaps the best way to regard the compression ratio is in terms of latent heat efficiency. The higher the compression ratio, between the same temperature conditions, the higher the molar latent heat will be, meaning that, if the specific heat remains the same, the latent heat efficiency is greater, and therefore the more efficient the refrigerant will be.

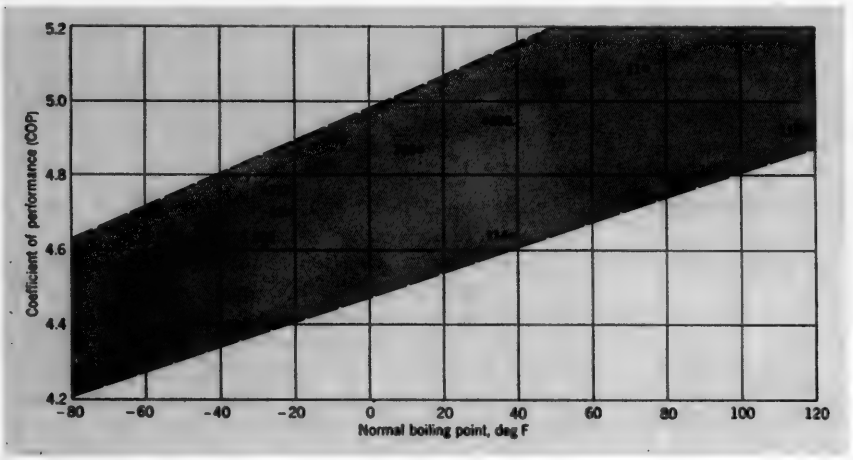


Fig. 7. Effect of boiling point on the COP for some refrigerants.

Comparative Characteristics

Data, given in Table 1, were, in general, taken from Reed and are used to depict the relations existing between various characteristics of refrigerants. Thirteen refrigerants are listed in this table.

The values for horsepower per ton were calculated from the *COP*. Obviously,

$$H_p = K(W/Q_1), \qquad (12)$$

where H_p is the horsepower per ton, W/Q_1 is the reciprocal of the *COP*, and K is a constant. Reed's values for 13B1 and 21 are not consistent with Equation (12), which is a precise relationship.

The normal boiling point affects the compression ratio as shown in Fig. 5; the relation is linear. There is no question that the compression ratio increases with the normal boiling point. Likewise, the molar latent heat of vaporization at the normal boiling point is, on an average, a straight line function[4] of the normal point, as shown in Fig. 6. The data fitted by law of least squares give the following formula.

$$y = 9446 + 20.89x, \qquad (13)$$

where x is the boiling point in deg F and y is the molar latent heat of vaporization in Btu per pound mole. The *COP* is also affected by the normal boiling, the relation again being linear as shown in Figure 7, where a least squares fitting gives

$$y = 4.749 + 0.003223x, \qquad (14)$$

x being the boiling point and y being the *COP*.

On the introduction of the concept of latent heat efficiency into the literature,[3] it was shown that, for standard ton conditions, the product of the horsepower per ton (H_p) and latent heat efficiency (L_v) is a constant:

$$H_pL_v = 74.703. \qquad (15)$$

[4] Pennington and Reed, *Modern Refrig.*, 53, 123 (1950).

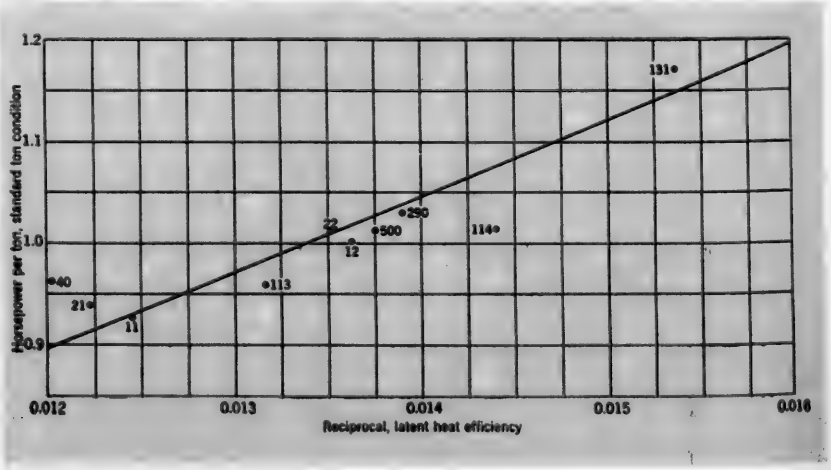


Fig. 8. Effect of latent heat efficiency on horsepower per ton for some refrigerants.

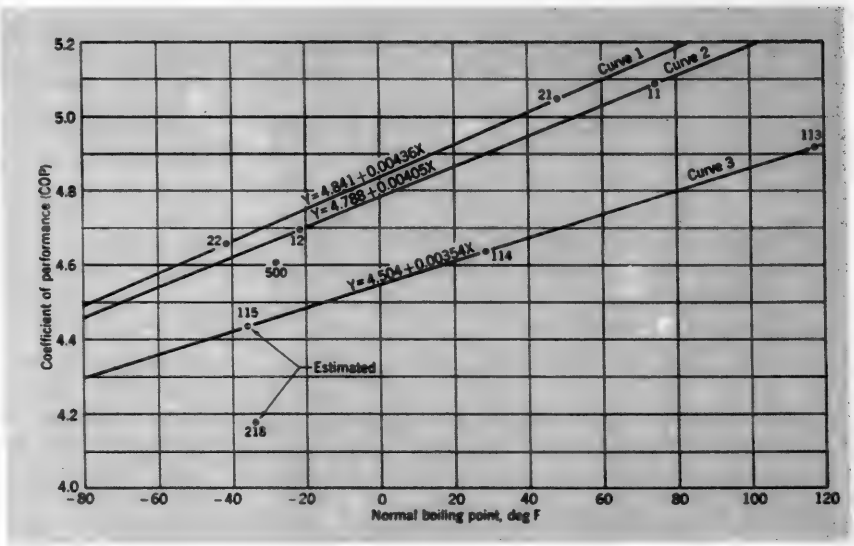


Fig. 9. Effect of boiling point on COP for various classes of refrigerants.

The relation is shown graphically in Fig. 8. The data fall fairly close to the straight line except those for CH_3Cl and 114.

An equation similar to Equation (15) for the condition where the evaporator is at 0 deg and the condenser is at 100 deg was used to estimate the horsepower per ton for 115 from limited data. It was found to be about 35% higher than that for 22. The data in Fig. 7 are referred to for an estimate for the standard ton.

Obviously the scatter is such as to suggest a classification as to types of molecules. This classification has been made and the results appear graphically in Fig. 9. The equations of the straight lines appear in the figure and were obtained in each case from two points.

In a given class, it is obvious that increasing the number of carbon atoms lowers the COP and increasing the number of hydrogen atoms increases the COP. In other words, more carbon atoms per molecule increase the horsepower; more hydrogen atoms decrease the COP value.

If the 113-114 line is extrapolated to a boiling point of −36 deg for Refrigerant 115, it will be found that the *COP* is 4.377 giving by Equation (12), using Refrigerant 12 to evaluate the constant, a value of 1.077 as the horsepower per ton for 115. This value is only 6.4% higher than that for Refrigerant 22. The agreement with the relative value of 35% given in a previous publication[3] for the cycle 0-100 deg is not at all good. The former estimate of the horsepower requirement for 115 is not realistic. Refrigerant 115 appears to be a much better refrigerant than was indicated.

TABLE 2—RELIABILITY OF THE REFRIGERANT PERFORMANCE EQUATION

Refrig. No.	Normal Boiling Point, Deg F	COP (obs.)	COP (calc.)	% Deviation
290	—44.2	4.58	4.551	+0.63
22	—41.4	4.66	4.671	—0.24
115	—36.4	—	4.367	—
218	—34.3	—	4.214	—
500	—28.0	4.61	4.643	—0.72
12	—21.7	4.70	4.700	0.00
40	—10.8	4.90	4.902	—0.04
600	31.3	4.95	4.838	+2.26
114	38.4	4.64	4.652	—0.26
21	48.0	5.05	5.037	+0.26
11	74.7	5.09	5.090	0.00
C_4F_{10}	84.8	—	4.527	—
113	117.6	4.92	4.953	—0.91

TABLE 3—STANDARD TON REFRIGERATION CAPACITY OF SOME REFRIGERANTS

Refrig. No.	Boil. Pt., Deg F	Pressure (5 deg)	Tons
113	117.6	0.980	5.77
11	74.7	2.931	16.00
21	48.0	5.243	28.47
114	38.4	6.772	29.69
12	—21.7	26.51	100.00
500	—28.0	31.08	116.3
218	—34.3	35.85	——
115	—36.4	——	——
22	—41.4	43.02	161.7

Coefficient of Performance

With a little mathematical manipulation into the empirical, it has been possible to develop, for the standard ton, the following relation from the data for Refrigerants 11, 12, 21, 22, 113, and 114:

$$C_{\pi} = (1.011)^{H}(1.00000-0.19599\log C)(4.788 - 0.00405B_p), \quad (16)$$

where C_π is the *COP*, H is the number of hydrogen atoms per molecule, C is the number of carbon atoms per molecule, and B_p is the normal boiling point, deg F. This equation is called the "refrigerant performance".

Data are given in Table 2 to demonstrate what has been wrested in the way of scientific classification out of the somewhat chaotic picture shown in Fig. 7. Aside from Refrigerant 600 (C_4H_{10}) the calculated and observed values agree as well as could ever be expected. It is not at all certain that Reed had reliable data for his calculation for 600.

Calculated values for three other refrigerants which may be employed in the future have also been put in the table; reference will be made to them later.

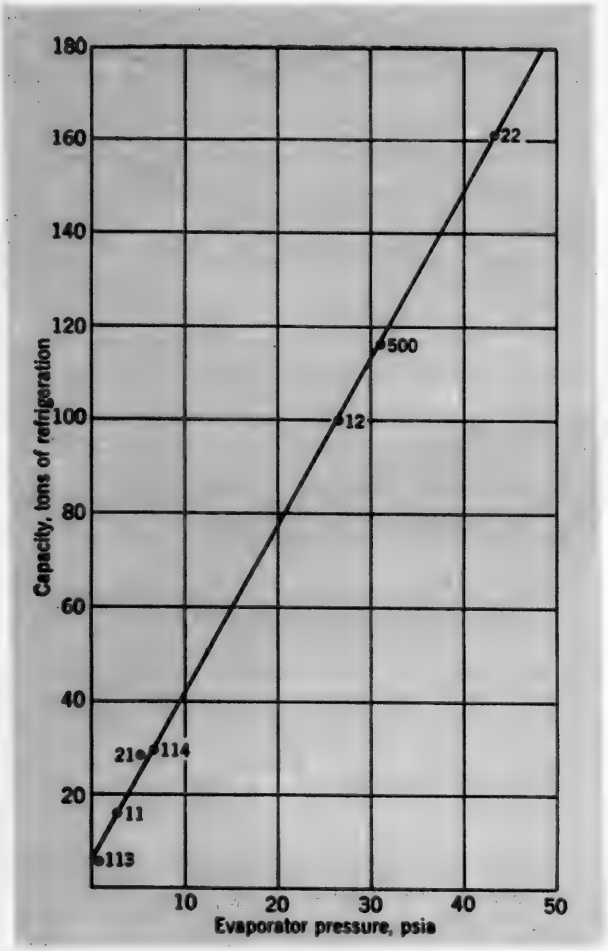


Fig. 10. Refrigeration capacity as related to evaporator pressure for some refrigerants.

Refrigeration Capacity

Different refrigerants, where used in identical machines with appropriate motors, will yield different refrigeration capacity in each case. Advantage has been taken of this fact to use the same compressor in air conditioning for several applications. A 30-ton unit designed for Refrigerant 12 will have a capacity of 35 tons with Refrigerant 500 and 45 tons with Refrigerant 22. Using the different refrigerants in this way results in some genuine savings for the manufacturer of air conditioning and refrigeration equipment. A new refrigerant is needed to fill the gap in between Refrigerant 500 and 22; one that can give 40 tons capacity in the above unit designed to give 30 tons with 12.

Table 3 shows how the standard ton refrigeration capacity of some refrigerants varies with the normal boiling point and also with the pressure. A machine which will give 100 tons with Refrigerant 12 has been considered in the calculations with the speed of the compressor constant for all refrigerants. Sufficient data are not at hand to analyze Refrigerant 115 and 218, but their boiling points indicate that one of them may serve as the intermediate between 500 and 22. It is feared, however, that they may be so inefficient as to have capacity values much lower than the pressures would indicate. Incidentally the values given in the table indicate that the capacity is close to a linear function of the evaporator pressure. See Fig. 10 in which the line has merely been placed by inspection.

One can visualize the importance, in air conditioning, of using different refrigerants with the same compressor when he considers that a line of compressors 3, 5, 10, 15, 25, 35, and 50 tons in capacity, where Refrigerant 12 is used, will give 3.6, 6, 12, 18, 30, 42.5, and 60 tons where Refrigerant 500 is used. Thus the number of sizes are doubled without any redesign and new tooling.

Low Temperature Refrigerants

In order to cool to a temperature of, say −125 deg, it is important to have a refrigerant with adequate pressure so that the compressor will not need to be unduly large. For such a service, some of the refrigerants listed in Table 4 may be used:

TABLE 4—LOW TEMPERATURE REFRIGERANTS

Refrigerant No.	Formula	Boil. Pt., Deg F	Critical Temp, Deg F	Status
13B1	$CBrF_3$	— 73.6	153.5	S
116	CF_3CF_3	—108.8	——	—
13	$CClF_3$	—114.6	83.9	C
23	CHF_3	—119.9	——	D
14	CF_4	—198.4	—49.9	S

In the column headed "Status", *D* denotes in the development stage, *S* semicommercial, and *C* commercial.

The critical temperature is so low in many of these refrigerants that they cannot be condensed in the vicinity of 100 deg where heat is finally rejected from so many commercial systems. It becomes expedient to use a cascade system involving two refrigerants. Refrigerant 13 can be used to pump heat from an evaporator at −125 up to −20 deg where its heat of condensation is transferred to boiling Refrigerant 12 which condenses at 100 deg transferring the heat to cooling water. Missimer[5] describes systems using 12 or 22 as the high stage refrigerant and 13 or 13B1 as the low stage refrigerant. Table 5 contains data from his paper.

High Molecular Weight Refrigerants

While high molecular weight should be avoided in refrigerants used in compression refrigeration, just the

[5] Missimer, *Refrigeration Engineering, 64*, No. 2, 37-42 (1956).

TABLE 5—CHARACTERISTICS IN SOME CASCADE SYSTEMS

Combination	Refrig. No.	Stage	Temperature, Deg F		Pressure, psia	
			Evaporator	Condenser	Evaporator	Condenser
	12	High	— 30	100	——	——
1	13	Low	—125	—20	10.5	126.4
2	13B1	Low	—114	—20	4.1	48.9
	22	High	— 50	100	——	——
3	13	Low	—134	—40	7.3	87.4
4	13B1	Low	—127	—40	2.7	32.4

TABLE 6—HIGH MOLECULAR WEIGHT REFRIGERANT

Refrig. No.	Formula	Molecular Weight	Boil. Pt., Deg F
227	C_3HF_7	170	3.3
—	C_4F_{10}	238	28.9
12B2	CBr_2F_2	210	73.6
—	C_5F_{12}	288	84.9
319	C_4ClF_9	254.5	85.7
216	$C_3Cl_2F_6$	221	95.0

opposite holds in centrifugal refrigeration. As a matter of fact, the greater the molecular weight the fewer stages are required in the impeller. It is now visualized that a single stage impeller may be used if suitable refrigerants can be found with molecular weights around 300. Three such refrigerants with boiling points of 75, 100, and 125 deg could probably find immediate application. Table 6 contains some high molecular weight compounds in which interest has been shown.

Badylkes[6] has proposed CF_2ClBr, CBr_2F_2 and $(CBrF_2)_2$ for use in single stage compressors, stating that an evaporator temperature of 15 deg and a condensing temperature as high as 160 deg can be used.

Azeotropic Refrigerants

An azeotropic solution is one containing at least two components that boils at some given pressure without change in composition. The term "azeotrope" refers to the solution with the exact composition which is azeotropic. An azeotropic system is a chemical system in which an azeotropic solution exists for some temperature.

To illustrate, a solution of Refrigerants 152a and 12 containing 26.2% 152a is an azeotropic solution at 32 deg F. The solution of this composition is also called the azeotrope at 32 deg. The chemical system, Refrigerants 152a and 12, is an azeotropic system whether one knows the azeotropic composition or not. One may use a solution in an azeotropic system without that solution being the azeotrope. A maximum pressure azeotropic system can be fractionated in a distilling column to give the azeotrope at the top and one of the pure constituents at the bottom; which one depends upon which side of the azeotropic composition the feed solution is on. Homoazeotrope refers to an azeotrope in a single liquid phase.

Refrigerant 500 is an azeotropic mixture (32 deg) containing 26.2% Refrigerant 152 and 73.8% 12. It was developed to be used commercially in a machine, designed for Refrigerant 12 and 60 cycle current, to give the same capacity where 50 cycle current is employed. Another encouragement toward its development was the extension

TABLE 7—AZEOTROPIC REFRIGERANTS

Combination	Boiling Point, Deg F (1)	(2)	A_z	Wt % of 1
152-12	—11.4	—21.7	—28.0	26.2
12-22	—21.7	—41.4	—41.45	2
40-12	—10.8	—21.7	—25.6	22
115-22	—36.4	—41.4	—50	50
22-290	—41.4	—44.2	—49	68
21-114	48.0	38.4	34.5	25
218-22	—34.4	—41.4	—45	54
227-12	3.3	—21.7	—22	13.5
$(CH_3)_2O$-12	—10.5	—21.7	—22	10
152-115	—11.4	—36.4	—42	16

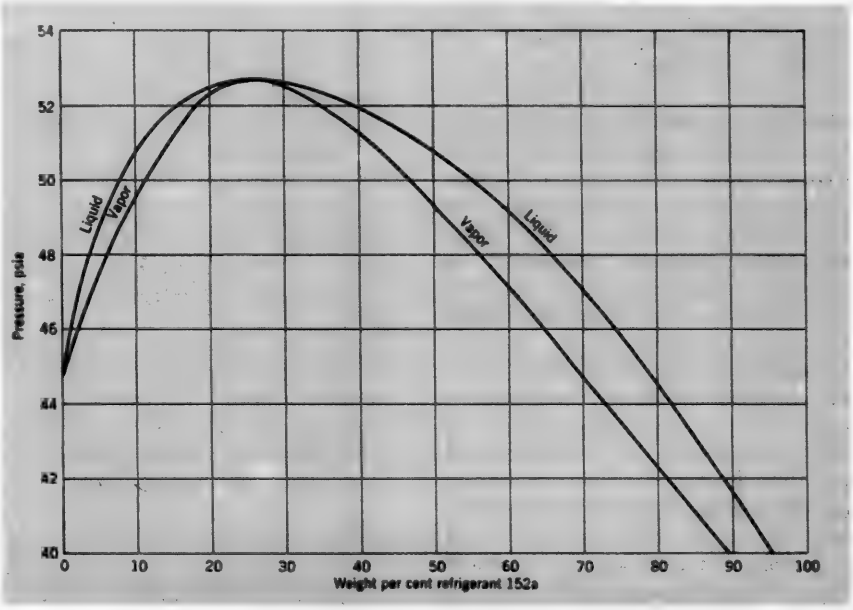


Fig. 11. Equilibrium pressure-composition diagram, Refrigerants 152a and 12 at 32 deg F.

[6] Badylkes—Congress Intern. Froid, 9e, Paris (1955), Comp. rend. trav. comm. 111 3040-50.

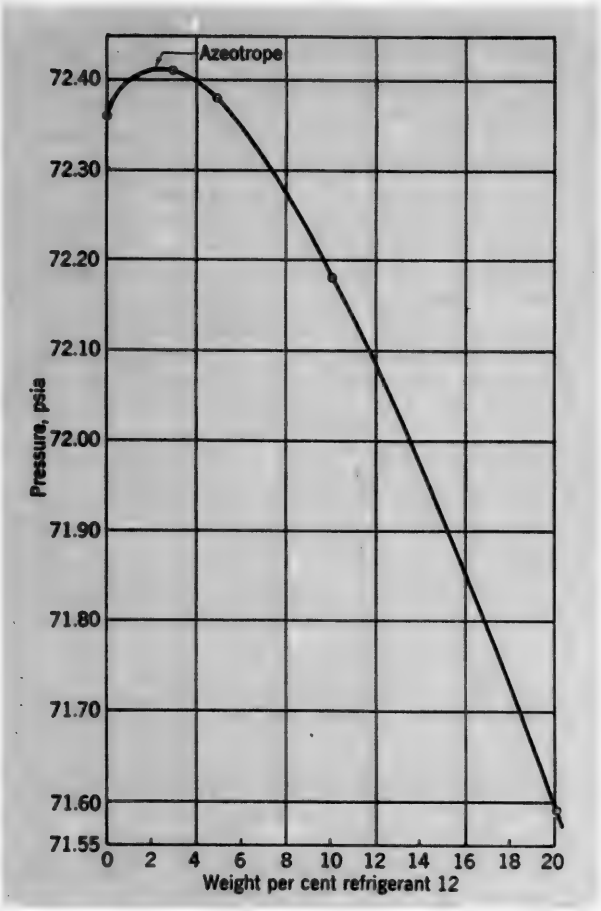


Fig. 12. Pressure-composition diagram, Refrigerants 12 and 22 at 32 deg. F.

and filling in of sizes in a given line of compressors. While it is the only azeotropic mixture known to the writer to be used commercially, there are many other azeotropes not yet made commercial. Some of these are given in Table 7. The boiling points are given in the order of appearance in the combination column, No. 1 always being the higher boiling constituent. The last column contains the weight percentage of the higher boiling constituent.

The pressure-composition for the system, Refrigerants 152a and 12, at 32 deg is shown in Fig. 11 and a portion of the Refrigerants 12 and 22 system is given in Fig. 12. Both of these systems are azeotropic. Note the great increase in pressure of the azeotrope in the first system over the higher pressure constituent. In the 12-22 system, the azeotrope has a pressure only slightly above that of Refrigerant 22. The maximum (azeotrope) in the 12-22 system comes at about 2.1% 12 and not at 25% as indicated in ASRE Standard 34. This composition is completely off the chart on the low side in Fig. 12.

The pressure for the 12-22 system at 32 deg may be given by

$$p = 72.36x^{0.8593 - 0.0825x} + 44.77\,(1-x)^{0.9305 - 0.1308(1-x)}, \qquad (17)$$

where p is pressure in psia and x is the mole fraction Refrigerant 22.

There is no inherent advantage or disadvantage of an azeotrope or any other mixture insofar as thermodynamic properties are concerned. There is a feeling among some mechanical engineers that a mixture, other than an azeotrope, requires more horsepower per ton just because it is a mixture. This is not true as is shown in Fig. 13 where curves are given for various mixtures showing the results of calorimeter tests. The mixtures 21-22 and 114-22 were of such composition as to give the same pressure at 32 deg as 12 has. Three points were found for each composition. The abscissa gives the Btu per min transferred from an electric heater to the boiling refrigerant. The ordinate is the rate of heat transfer per watt hour for the motor.

Obviously 21-22 is more efficient than 12 and 114-22 is less efficient. This is to be expected almost quantitatively from the following facts:

Refrigerant	*Latent heat efficiency, Standard ton*
12	73.51
22	74.03
114	69.54
21	81.77

Since 22 and 12 have almost identical values for L_v and 114 has a lower value, a mixture of 22-114 would be expected to require more horsepower per ton, not because it is a mixture, but because it is 22-114. Refrigerant 21 has the best value for latent heat efficiency. Thus it is not surprising that more heat can be transferred with the same work using 21-22; the horsepower per ton will be less for the mixture than where 12 is used.

Advantages of Nonazeotropic Mixtures

Already mixtures of 12 and 22 far from the azeo-

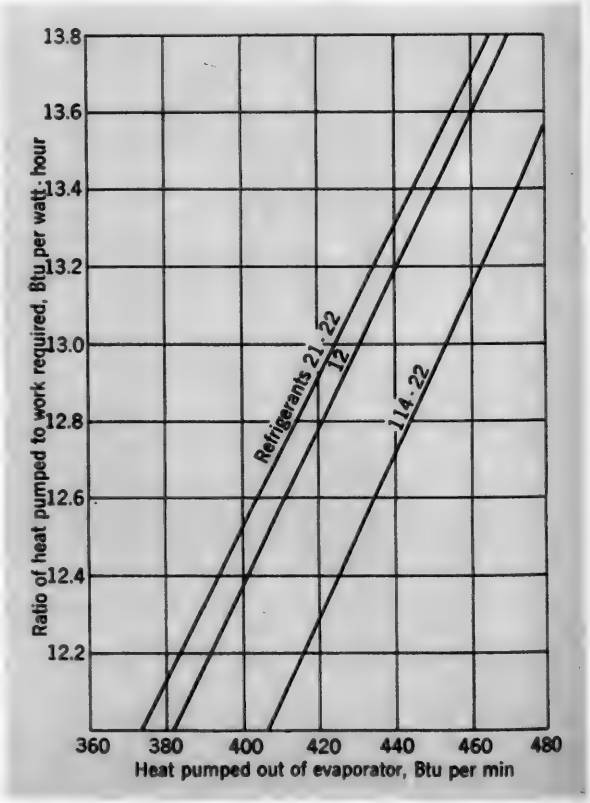


Fig. 13. Capacity tests on nonazeotropic mixtures.

tropic composition are being used as refrigerants primarily because the addition of 12 increases the oil solubility and makes it possible to get much better oil return to the compressor. One can use up to about 25% (by weight) of Refrigerant 12 without getting a great deal of change in capacity.

From time to time other mixtures may be employed for very specific reasons. Food freezers have been operated with a mixture of 114-22 in a very satisfactory manner. The refrigerant at the beginning of the evaporator may be −40 deg and at the ending near 0 deg while the motor is running. Once the motor is cut off by the thermostat, the liquid refrigerant will come from the high side into the evaporator, the last portion being as high as 50 deg. The heat in this "hot" refrigerant has not the slightest chance of doing any damage on the refrigerated food around it. The temperature of this part of the refrigerant is very quickly far below 0 deg because of the enormous amount of sensible heat required to raise the temperature of the food. The average temperature at various spots in the cabinet were quite close to what they were where Refrigerant 12 was used. While such a mixture can be employed in a food freezer there seems to be no advantage whatsoever in using it.

Refrigerants for Absorption Refrigeration

Were there sufficient water at, say, 45 deg, just under the surface of the earth, it could be used directly to give all the air conditioning that would be desired. There is no such supply. However, there is a considerable amount at such a temperature so that it can be employed to maintain temperatures as low as 110 deg or lower.

Here is where absorption refrigeration comes in. Water is used to keep a solution such as 61% lithium bromide in water at a temperature not exceeding 110 deg. This salt solution, in turn, keeps the refrigerant, boiling water, at a temperature near 40 deg which then can be pumped around a circuit to collect heat thereby producing air conditioning. The lithium bromide solution and liquid water have the same vapor above them, namely, water vapor. A 61% LiBr solution has the same vapor pressure at 110 deg that liquid water has at 38 deg. Consequently if chambers containing the two are in communication and held at the above mentioned temperatures, respectively, there will be no flow of vapor. If the water were at 40 deg its vapor pressure will be higher and vapor will flow into the salt solution making it more dilute. This is exactly what happens in the lithium bromide absorption air conditioning machine. The condensation of the vapor into the salt solution takes the place of the compressor. In a working machine there must be a driving force so that the 61% LiBr solution cannot cool water down to 38 deg except at zero load. At full load the water may be 10 deg higher.

TABLE 8—SOME ABSORBENT-REFRIGERANT COMBINATIONS

No.	Absorbent	Refrigerant	Boil. Pt., Deg F
1	LiBr	H_2O	212
2	$(CH_3)_2SO$	H_2O	212
3	H_2O	NH_3	—28
4	$LiNO_3$	NH_3	—28
5	DETG	21	48
6	DETG	22	—41.4

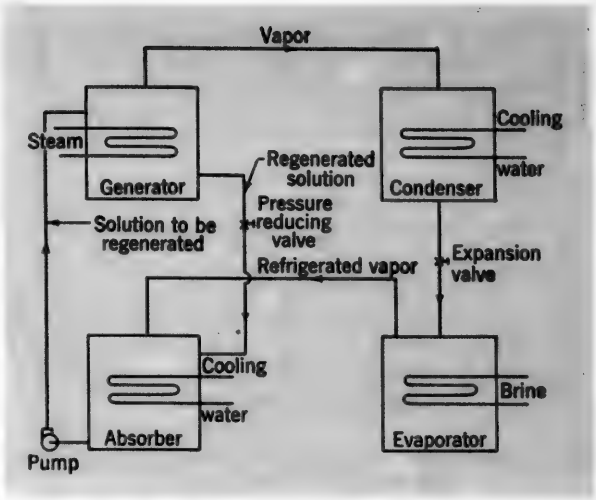


Fig. 14. Simple absorption refrigeration cycle.

The absorbing solution becomes more dilute and will become ineffective unless it is concentrated. To accomplish this it is pumped into a generator where steam is used to boil off water concentrating the solution which is returned to the absorber. The water boiled off is condensed through the use of cooling water and thus the refrigerant is recovered; it is returned to the evaporator. Details of the simple absorption cycle are illustrated in Fig. 14.

The absorption cycle just referred to is in practical use in air conditioning in machines from some few up to perhaps 1000 tons capacity. This cycle can truly be appreciated when it is realized that it would require a reciprocating compressor with about 6400 cylinders 4 inches in diameter with a 6-inch stroke to give a 1000 tons if the crankshaft were rotating at 1760 revolutions per minute. Of course the cylinders might be much larger. Reciprocating compression is impractical in any event where water is the refrigerant. The absorption cycle makes it possible to use water, a very good refrigerant thermodynamically. The water vapor velocity in parts of the absorption machine is probably as much as 300 miles an hour—a beneficient, controlled tornado!

In passing it is well to mention that water is used as the refrigerant in a steam jet system where water vapor from the evaporator is entrained in a fast moving jet of steam.

Ammonia is also used in absorption refrigeration. The gas fired home refrigerator uses an ammonia-water solution as the absorbent and ammonia as the refrigerant. Ammonia has also been tested in a large pilot model where a concentrated solution of lithium nitrate in anhydrous ammonia is the absorbent and ammonia is the refrigerant. Technically it works, but may not prove to be economically feasible.

Among chemical systems which have been proposed for absorption systems are those listed in Table 8; the two systems just discussed are also included. *DETG* is used to designate dimethyl ether of tetramethylene glycol. The absorbing solution is actually a concentrated solution of the absorbent and the refrigerant.

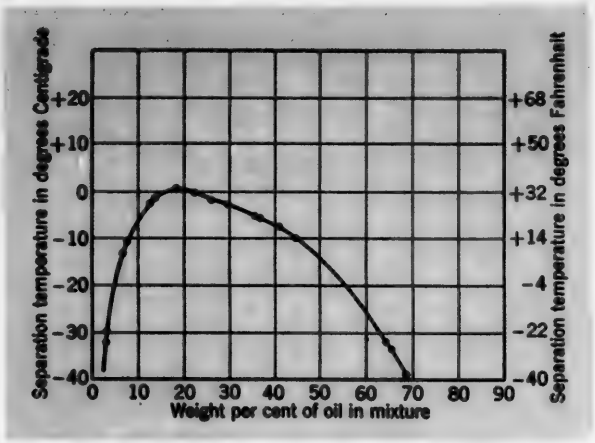


Fig. 15. Equilibrium diagram, Refrigerant 22 and Suniso 3G oil (after Walker *et al*).

Oil Solubility

All hydrocarbons and the halocarbons containing no hydrogen and much chlorine are completely miscible in the oils employed normally in refrigeration systems. This is a good characteristic.

When the motor stops in a refrigeration system the liquid refrigerant evaporates, over a time, and condenses in the oil in the basin in the housing containing the compressor. On the start-up, the oil-refrigerant mixture will foam and some of this goes over into the condenser and thence into the evaporator. If the oil and refrigerant are completely miscible at the low temperature, the oil will return and a separation will be made with the warm up, leaving the oil where it belongs.

If there is considerable fluorine or fluorine with hydrogen and little or no chlorine in the molecule, the oil ordinarily used is not miscible to a large extent with the refrigerant. Refrigerant 13 ($CClF_3$) and 14 (CF_4) are almost completely immiscible; so is 218 (C_3F_8) and 152a (CH_3CHF_2). Intermediate compositions such as Refrigerant 22 ($CHClF_2$) are completely miscible at room temperature, but have limited solubility at low temperature.

Figure 15 has been taken from Walker,[7] Sakhnorsky, and Rosen to represent the behavior of Refrigerant 22 with Suniso 3G oil. Below 0 deg there are two phases in the oil-refrigerant mixture for certain compositions. At —10 deg, 8% oil is all that is needed to form two liquids. This is why in a low temperature system oil separators are needed.

There has been a marked trend toward the use of Refrigerant 22, instead of 12, in the last several years because of its having a higher pressure at the same temperature. Many difficulties have arisen in trying to make the change and this is the primary reason for using the mixture of 12 and 22 containing 25% 12. The mixture should be used if a refrigerant capacity must be had in this range, but calling it an azeotrope, when it is not, does not enhance its properties.

Steinle[8] has reported that secondary butyl polysilicate esters can be used as oils in Refrigerant 22 systems. It has a viscosity of 55 centistokes at 68 deg and is miscible in all proportions with 22 down to —108 deg (dry ice temperature).

Water Solubility

Moisture inside the circulating system has caused a great deal of difficulty in refrigeration systems. Great pains are taken to dehydrate the systems, particularly the hermetic units where the motor is on the inside of the refrigerant system. For years this dehydration was effected with vacuum at 275 deg. In later years, some use an air sweep instead of vacuum. The latter method should be seriously questioned for low temperature systems because of the tendency to oxidize the small amount of oil put in for the short time initial run in test of the motor and compressor.

Table 9 shows the solubility of water in Refrigerants 12 and 22 in parts per million. Most other halocarbons used have solubilities not too different. Refrigerant 12 has more water in the vapor; Refrigerant 22, in the liquid. A pressure-composition diagram for 12 and water

[7] Walker, Sakhnovsky, and Rosen, *Refrig. Eng.*, 65, No. 3, 38-45 (1957).

[8] Steinle, *Kaltetechnik*, 8, 12-14 (1956).

TABLE 9†—SOLUBILITY (ppm) OF WATER IN REFRIGERANTS 12 AND 22

Temperature, Deg F	Refrigerant 12		Refrigerant 22	
	Liquid	Vapor	Liquid	Vapor
—40	1.7	29.1	120	24.4
0	8.3	110.4	308	92.7
40	32	323.2	690	268.4
80	98	——	1350	——
100	165	——	1800	——

† Based on a table by Reed, *Air Conditioning and Refrigeration News;* reproduced by permission.

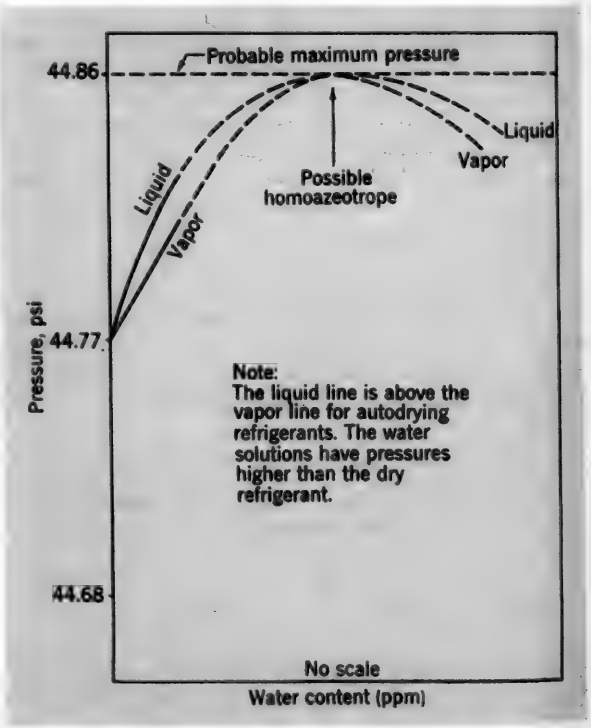


Fig. 16. Type pressure-composition diagram for Refrigerant 12 and water at 32 deg. F.

would be of the type shown in Fig. 16. A homoazeotrope exists in the system unless the solubility runs out before it is reached.

Refrigerant 12 is autodrying, meaning that the liquid becomes drier during distillation; 22 is autowetting.

Fig. 17 shows[12] how much water is in the desiccant Sovabeads, a type of silica gel, where the temperature is 100 deg for various moisture contents in Refrigerant 12.

If one gets 3 ppm in a new unit just run in and then after a year of operation gets 9 ppm, he can know if

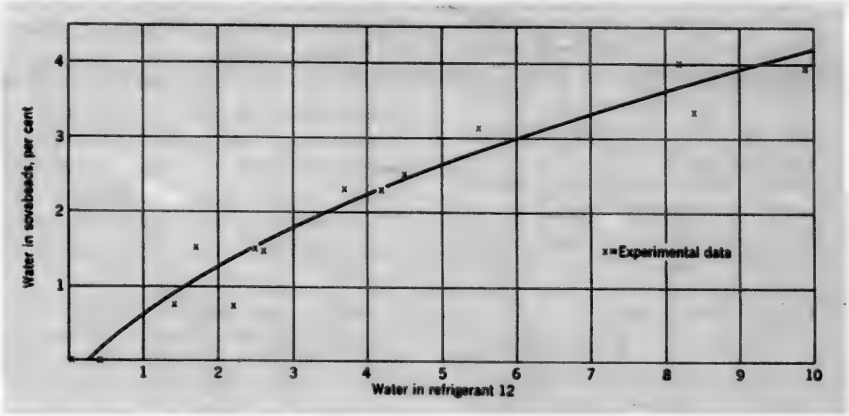


Fig. 17. Moisture equilibrium relation with drier at 100 deg F.

Where moisture is determined[9] by absorption in phosphorus pentoxide, it is not necessary to sweep out the sample cylinder, if it is made of proper materials, after the distillation.

For moisture analyses of Refrigerant 22, it is imperative to have a dry gas sweep or otherwise some of the moisture will be left in the cylinder and low values will be obtained.

Several methods have been worked out for the determination of moisture in refrigerants. Taylor[10] discusses a new instrument. The industry was in a chaotic condition on this matter until recently if, indeed, it still is not. Very few people making analysis really understand how to get reliable values. A bulletin published in 1931 and reprinted as late as 1943[11] described a technique wholly inadequate to get correct analyses. The work reported in Reference 9 was done to perfect the absorption technique. Circular No. 8 describes a method for using the same absorbent.

One great advantage in being able to analyze a refrigerant for moisture accurately is to learn indirectly about a great many things in a refrigeration system. A refrigerant sample taken from a system containing a desiccant and which has been run for a few hours can be used to learn how much water is in the desiccant.

TABLE 10 — DRIER CAPACITY IN A REFRIGERANT 12 FOOD FREEZER

Condition No.	Temperature, Deg F			Relative % Liq.	Water in Gel, %
	Drier	Evaporator	Condenser		
1	—10	—10	95	80	36
2	—10	—10	95	60	26
3	0	—10	95	0	14
4	0	0	130	75	35.6
5	20	20	100	75	34
6	70	0	130	100	8
7	95	—10	95	100	8
8	130	0	130	100	4

there is 25 grams of the gel in the drier that roughly 0.6 grams of water have gone into the drier within the year. Did it come from improper dehydration or from a breakdown of insulation in the motor? The writer has run several units for a yearly period and found no difference in the moisture content of the refrigerant. Such results prove conclusively that the dehydration was perfect and there was no motor breakdown.

All low temperature systems ought to have a drier in them and in general it should be placed where the refrigerant has the lowest, not the highest, solubility for water. It will always be the low temperature side. Whether it should be at the beginning of the evaporator or in the vapor space beyond the evaporator depends on several factors, the solubility of water in the different phases being among them. The data in Table 9 show conclusively that a drier at the beginning of the evaporator for a Refrigerant 12 system will have the greatest capacity. One must take the fouling with oil into consideration before putting the drier in the vapor space.

Data in Table 10 show[12] the capacity of silica gel type driers at different locations and under different operating conditions in a Refrigerant 12 food freezer. The absorbing capacity of silica gel at the beginning of the evaporation is nine times as much as it is in the high side liquid at 130 deg.

Manufacturers guarantee less than 10 ppm in many refrigerants. This number is taken far too seriously. It is not the few parts per million entering the system that cause trouble, it is the milliliters that are not pumped out during evacuation because the valve to the system is never opened or it is the large amount that may leak in where the unit is being tested under water.

In a food freezer there is about 450 grams of refrigerants. If it contained 50 ppm, there would be only 0.02

[9] Pennington, Anal. Chem., *21*, 766-9 (1949).
[10] Taylor, *Refrig. Eng.* 64, No. 7, 41-47 (1956).
[11] ASRE Circular 8, 1931, reprinted in 1943.
[12] Pennington, *Refrig. Eng.*, 59, 272 (1951).

grams water introduced in the refrigerant, a mere trifle. A 25-gram drier where the unit is operated as Condition No. 1 will handle, therefore, 9 grams which is 450 times as much.

Air Solubility

Air or any other noncondensible in a refrigerant can best be determined through the use of a reflux apparatus where the gas can be driven into a comparatively small tube above the condensing refrigerant.

Air solubility has been determined by a rather complicated method using extremely low temperature.

One can determine quite accurately by simply measuring the total pressure at a given temperature. Since the solubility is low, Henry's Law works as perfectly as it ever would for anything. The writer is preparing a paper to be published, on this subject.

Communications in the Field of Refrigerants

Progress in the field of refrigerants has not kept pace in the modern era. This is due to improper communications on the technical level. How anyone could use the specific analytical technique, described in ASRE Circular Number 8, published in 1931, with confidence is hard to understand. Few chemists would boil away part of the sample and analyze the remaining portion to represent the sample. That is, he would not do it if he had control of his own science. A technique of the kind just described could never be employed to learn where to put a drier in a system, to learn if the system is sufficiently dry, or to find out if the motor insulation is breaking down in the operation of the system.

Even though information was and still is needed in the field of refrigerants, one may have most important information in his possession that can be given to his science only with the greatest difficulty because of trouble encountered in publication.

The state of communications can best be depicted by referring to a paper by one scientist published in 1952 in which he said that no published data are available on vapor-liquid equilibria for highly fluorinated systems and again in the very same paragraph that no other references relating to highly fluorinated compounds have been found.

The publication referred to in Reference 4 was published in 1950 and contains a pressure-composition diagram for the system Refrigerants 152a-12. This is a highly fluorinated system. It is referred to in abstract form: CA6774b (1951). The same diagram was published in another journal,[13] the paper being abstracted: CA10215e (1950).

Dichlorodifluoromethane (Refrigerant 12, a popular refrigerant) was one of the main compounds used in this investigation. In the 1950 Subject Index of Chemical Abstracts under "Methane, dichlorodifluoro—"on page 12554 can be found a reference to a paper entitled "Azeotrope with 1,1-difluoroethane as a refrigerant." If communications were right this paper would have been found.

Communications, in the refrigerant field, are poor, not only between various laboratories or individuals widely separated, but even within the same company.

The Future

There is much research that can profitably be carried out in the field of refrigerants. A great deal of it, particularly the part looking toward the development of new refrigerants to be used for special purposes, should be done under the guidance of physical chemists.

There are a multiplicity of field problems involving Refrigerant 22 as it is replacing Refrigerant 12. The help of mechanical engineers, chemical engineers, chemists, and other scientists who will contribute is sorely needed.

A great deal of work needs to be done on the determination of the refrigeration capacity of new refrigerants and other fundamentals.

Much research should be carried out on methods of preparation of high molecular weight refrigerants. One day a single one-stage impeller may be used in centrifugal compressors to give tonnages from 75 to 2000 in suitable increments by using different refrigerants.

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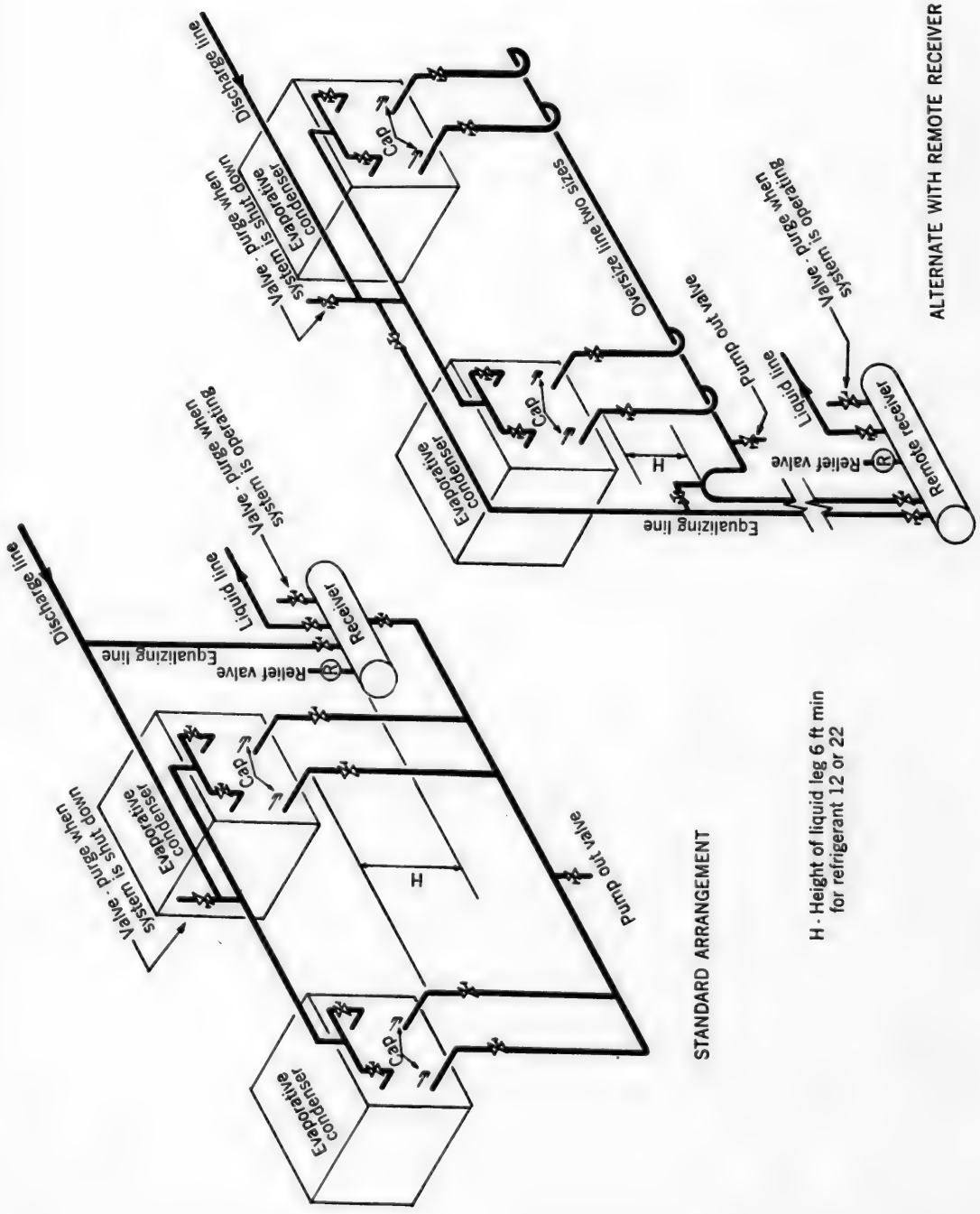
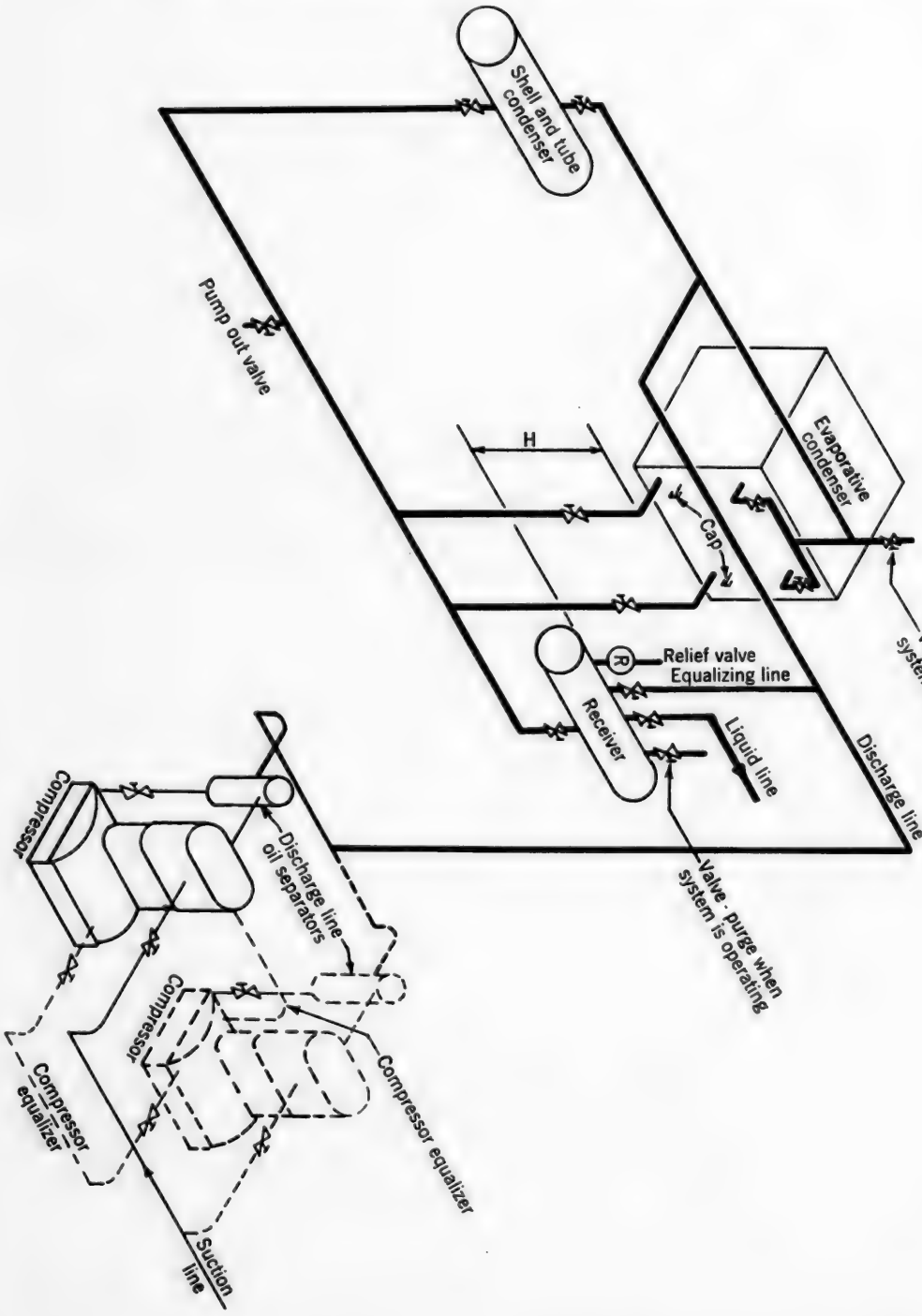
[13] Pennington and Reed, *Chem. Eng. Prog.*, 46, 464-6 (1950).

PIPING FOR EVAPORATIVE CONDENSER



PIPING FOR EVAPORATIVE CONDENSER

Two Types of Condensers in Parallel With One or More Compressors



Drawings on This and Reverse Side
Courtesy of Baltimore Aircoil Co., Baltimore, Md.

Dirt Control Rivals Climate Conditioning in

Super-Clean Testing Labs

Cleanliness, a very relative condition, seems to have reached an ultimate state in the dirt- and climate-controlled testing areas of this modern laboratories building. Weapons against dirt include air pressure, lighting intensity, and gelatin.

THE one-story, fully air-conditioned laboratories building recently completed by Federal Telecommunication Laboratories, largest research and development division of International Telephone and Telegraph Corporation, is located in San Fernando, Calif., providing facilities and equipment to conduct the most exacting research and development activity. Three unusual types of working area have been provided:

(1) a super-clean area for assembly and testing of micro-mechanical devices such as gyroscopes or other inertial navigation devices;

(2) a vapor-controlled area whose atmosphere is drawn from a 40-ft tower to minimize contamination by automobile exhaust vapors, then treated to accurately control all its vapor content, including, especially, vapors from experiments in adjacent areas; and

(3) a "universal" area which is quickly convertible from private to semi-private offices to flexible and efficient electronic laboratories.

Design Features

The 22,400-sq ft building incorporates features which are seen to be precedent-setting for future laboratories. One such feature is the provision for an oscilloscope room separate from the super-clean rooms, but communicating therewith by means of a viewing window, plus a set of remote control panels carrying electrical cables and remote control shafts. Thus, oscilloscopes, voltmeters, and other inherently dirty electronic test equipment can be used by engineers in the super-clean room without bringing such test equipment physically into the area.

Another feature is the use of double walls between different project rooms in the vapor-controlled area with low-pressure air spaces between the walls to prevent the flow of vapor from one room to another. And, the method of comfort-conditioning the whole building by using separate air-to-air heat pumps is believed to be the first application of such units to an industrial building.

Six separate plumbing systems distribute hydrogen, oxygen, natural gas, and compressed air in addition to hot and cold water, and four separate waste disposal systems are provided for different types of waste water.

Super-Clean Rooms

For inertial navigation research and development involving development and testing of high-precision gyroscopes and other guidance and control components, control of dust and air temperatures is critical; humidity should be fairly low to avoid rust and perspiration. Consequently, the so-called super-clean rooms for gyro work in this laboratory are designed and built to keep out even the smallest particle of dust while holding the temperature at 71 deg F, plus or minus one deg, and keeping the humidity below 40%.

Here's the complicated procedure followed by a scientist or technician on entering the gyro test rooms:

He first enters a small air-lock painted a glossy jet black with the light intensity greater than 400 foot candles. Such a black room causes any particles to show up much more clearly than a conventional white or light-colored room. The air pressure in this air-lock is slightly above the normal building pressure so that air cannot leak in from the rest of the building.

He vacuums his clothing with a special attachment connected to a central vacuum system; he inserts each foot into a special automatic shoe-cleaning machine in which the shoe is buffed free of dirt which is sucked away immediately by the same central vacuum.

After donning special lint-free garments and cap, and applying lotion to exposed areas on neck, hands, wrists and eyebrows to prevent chapping in the low humidity and to minimize the flaking of skin, he proceeds to a second air-lock. There the air pressure is higher than in the first air-lock to prevent an influx of air currents. A special gelatin mat covers the floor to pick up any remaining dust particles from the shoes.

Finally, he proceeds to one of the gyro testing rooms in which the air pressure is still higher.

In these rooms, walls and ceiling are surfaced with non-porous high-gloss vinyl enamel; floors are of continuous vinyl plastic sheeting, instead of plastic tiles with the numerous cracks between the tiles. View panels of plate glass are built into one wall to permit observation from outside.

Both of the gyro test rooms are arranged adjacent to an oscilloscope room so that one technician in the scope room can assist testing personnel in both test rooms. Windows and control cables enable the oscilloscopes and other test equipment to be used remotely.

Machine Shops

Built into one corner of the gyro assembly room is a cleaning booth incorporating a revolving fixture in the wall. The fixture—reminiscent of a bank night-deposit device—is an air-tight passage to a precision machine

shop which qualifies as a clean-room itself.

The temperature in the precision shop is maintained accurately at 71 deg for proper operation of the unusually accurate machine tools and measuring equipment including many Swiss-made machines, a precision jig borer, and ultra-precise instrument and engine lathes. No grinding operations are permitted in the precision shop.

A so-called "dirty" machine shop containing several different types of grinding equipment, and a good general purpose machine shop with high-grade conventional machinery are located adjacent to a precision shop, but walled off for better control of dirt.

Additionally, a small shop containing grinder, lathe, drill press and hand tools is provided for the personal use of the staff of scientists and assistants.

Vapor-Controlled Rooms

Just across the corridor from the gyro testing rooms are five somewhat similar appearing rooms known as the vapor-controlled rooms. Since these five rooms are intended for solid state research where control of all vapors is critical, they are designed with less attention to dust and more attention to control of vapors. All air used in the vapor-controlled rooms is drawn from an inlet in the top of the tower so as to minimize contamination by automobile exhaust. The air is electronically filtered, washed with a water spray, and filtered through activated carbon to absorb remaining traces of organic vapors. Since water vapor itself is an important element of the atmosphere, the percentage of such vapor is carefully controlled. Because complete elimination of humidity is medically undesirable, the humidity is held to a very constant level of approximately 22½%, plus or minus 2½%. In contrast, it should be noted that in the superclean rooms the humidity is merely maintained below 40% but need not be held accurately constant.

In the vapor-controlled rooms, the normal asphalt tile flooring and the special vinyl sheeting used in the superclean rooms would be objectionable because any such material emits small traces of organic fumes. The floors, therefore, are of inorganic terrazzo material. The paint used on the walls and ceiling also is of a special type having extremely low vapor tension.

Each of the partition walls between the vapor-controlled rooms is constructed as a double wall with two separate rows of studs, and the concealed space between these two walls is maintained at a lower pressure than in the vapor-controlled rooms. Thus, even if vapor should seep through one wall into this concealed space, it could not seep from this low-pressure point into the adjacent higher-pressure room. Pipe fittings entering the room are sealed and electrical fittings are of the gasketed type to prevent seepage. Electrical conduits are calked, and where they pass through the low pressure hollow wall small vents are provided to insure that the interior of the conduit also is at a reduced pressure.

Heat Gain Through Windows Shaded by Canvas Awnings

The value of canvas awnings in making a house cooler has long been recognized. However, home owners can now get an accurate estimate of just how much heat they will exclude from a room, thanks to information compiled by researchers of the American Society of Heating and Air-Conditioning Engineers who recently completed a study, "Heat Gain Through Windows Shaded by Canvas Awnings." A report of their findings was presented at the semi-annual meeting of the ASHAE in Minneapolis.

Highlights of the report are:

1. Canvas awnings can prevent 55 to 77% of the solar heat from entering a window during a day's time, with best results being obtained from awnings over western-exposed windows.
2. Light-colored awnings are more effective than dark.
3. The difference venting makes in the temperature of the air under an awning is not a vital factor in the awning's efficiency.
4. Conventional awnings with sides are more effective at reducing room temperatures than the venetian style without sides.
5. Opaque canvas awnings are more effective than woven plastic fabric awnings, whose loose weave permits the passage of significant amounts of sunlight.

Experiments on which the report is based were conducted under simulated household conditions at ASHAE headquarters in Cleveland. The project was subsidized by the Canvas Awning Institute and Canvas Products Association International.

Using a 44¼ by 44¼-inch test window, engineers measured the amount of heat transferred directly through the glass, called transmitted head gain, as well as the convected-radiated heat gain, which represents heat dissipated into the room by the warmed window glass. The transmitted heat gain is the result of direct solar radiation from the sun, diffuse solar radiation from the sky, reflected solar radiation from the surroundings, and low-temperature radiation from both sky and surroundings.

The relative importance of material, color, the shape and venting of awnings was investigated. Awnings selected for testing included:

1. Conventional type, canvas, outside dark green, underside grey-green.
2. Conventional type, canvas, outside white, underside grey.
3. Venetian type, canvas, outside dark green, underside grey-green.
4. Conventional type, woven plastic fabric, outside and underside dark green.

Researchers found the white awnings more effective than the dark-colored ones because they absorb less heat, and cause no appreciable warming of the air under the awning. For such awnings, venting (leaving an opening at the top to permit escape of air) is of no importance. In fact, the report indicates that venting generally is not a vital factor in awning efficiency.

Test supervisors were interested to find that the conventional type awning with ends is more effective at lowering room temperatures than the venetian type without ends. They concluded this is because more reflected solar radiation and diffuse radiation enters the open ends of the venetian type to increase the temperature of the glass, indicating more is to be gained from shading the window than from improving circulation of air under the awning.

Maintenance of Centrifugal Pumps

IGOR J. KARASSIK and ROY CARTER
Harrison Division, Worthington Corp.

Part I of a three-part article presents information on the annual inspection, discusses the frequency of a complete overhaul, and the dismantling of a centrifugal pump.

BECAUSE of the wide variation in types of centrifugal pumps, ranges in sizes, differences in materials used in the parts and, especially in design, any comments on maintenance must be restricted to those types of centrifugal pumps most commonly encountered. As in the case of installation and operation, the authors recommend that the manufacturer's instruction books be carefully studied before any attempt is made to service any particular pump.

The amount of knowledge the maintenance personnel should have about the pumps in their care depends upon the demands and complexities of the system in which the pumps are installed. In most cases, complete information of the mechanical construction given in the instruction books is sufficient. Generally, the maintenance personnel needs only know the rated conditions of service which are usually given on the pump nameplate. Occasionally, it is also necessary to have more complete information on the pump characteristics in order to provide adequate inspection and maintenance. In such cases a performance curve of the pump is required and if it is not included in the instruction book, it should be obtained from the pump manufacturer.

There is considerable difference of opinion as to what constitutes good practice in rebuilding certain worn parts such as wearing rings or shaft sleeves. As far as possible, procedures which have been successfully used will be mentioned and discussed in this group of articles, even though some of these practices are not fully recognized as good practice.

The problems arising in connection with the proper maintenance of centrifugal pumping equipment vary from very simple ones to those of a very complex nature. The type of service for which the pump is intended, the general construction of the pump, the relative complexity of the required repairs, the facilities available at the site and other factors enter into this decision, whether the necessary repairs will be carried out at the installation or at the pump manufacturer's plant. In a number of cases, especially when sufficient spare equipment is available, a pump in need of repairs is sent to the manufacturer's plant for complete overhauling. In other cases, repairs or overhauls are made locally by the mechanics servicing the installation. When expedient, service engineers from the pump manufacturer's plant execute repairs at the site.

Daily Observation of Pump Operation

In a station where operators are on constant duty, hourly and daily inspections should be made. While it is felt that a card record system is unnecessary for these inspections, the operator should be on the watch for irregularities in the operation of a pump and report immediately anything unusual which he detects. A change in the sound of a running pump should be investigated immediately. Bearing temperatures should be observed hourly. An abrupt change in bearing temperature is much more indicative of trouble than a constant high temperature. If the pump is fitted with ring oiled bearings, the proper functioning of the oil rings should be observed.

Stuffing box operation should likewise be observed hourly. The stuffing box leakage should be checked to see whether it is sufficient to provide cooling and lubrication of the packing but not excessive and wasteful.

A check of the pressure gages and flow indicator, if these are installed, should also be made hourly to see that proper operation is being maintained. If recording instruments are available, a daily check should be made to insure that the capacity output, pressure or power consumption do not indicate that something needs attention.

Semi-annual Inspection

It is good practice semi-annually to check for free movement of the stuffing box gland, to clean and oil the gland bolts and nuts, and to inspect to see if the packing should be replaced.

The pump and driver alignment should be checked and corrected if necessary. Oil lubricated bearings should be drained and refilled with fresh oil. Grease lubricated bearings should be checked to see if the correct amount of grease is provided and that it is still of suitable consistency.

Annual Inspection

A very thorough inspection should be made of a centrifugal pump once a year. In addition to the semi-annual procedure, the bearings should be removed, cleaned and examined for flaws. The bearing housings should be carefully cleaned. In the case of anti-friction bearings, after cleaning they should be examined for scratches and wear. Care should be taken that dirt or moisture do not get into an anti-friction bearing and, immediately after inspection, such a bearing should be coated with oil or grease.

The packing should be removed and the shaft sleeves — or shaft if no sleeves are used — should be examined for wear.

The coupling halves should be disconnected and alignment checked. In the case of horizontal pumps with babbitt bearings, the vertical shaft movement for both ends should be checked with the packing out and the coupling disconnected. Any vertical movement over 150%

of the original play requires an investigation to determine the cause. The end play allowed by the bearings should also be checked and if it is in excess of that recommended by the manufacturer, the cause should be determined and corrected.

Drains, sealing water piping, and cooling water piping should be checked and flushed. If an oil cooler is used, it should be flushed and cleaned.

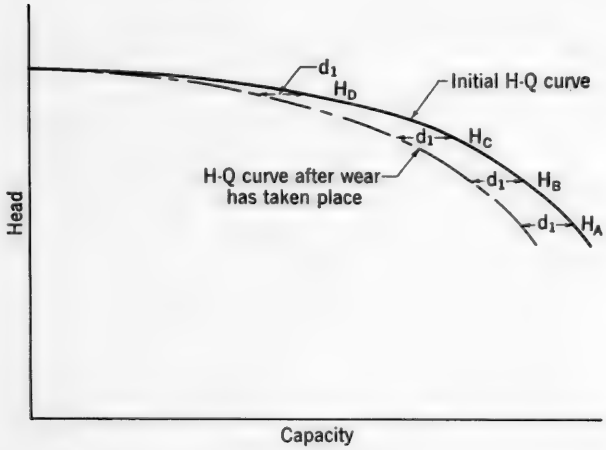


Fig. 1. Effect of internal wear on the head-capacity curve of a centrifugal pump.

The pump stuffing boxes should be repacked and the coupling reconnected.

If instrument and metering devices are available, these should be recalibrated and a test should first be made to determine whether proper performance is being obtained. If internal repairs are made, the pump should again be tested after completion of the repairs.

Complete Overhaul

The frequency and regularity of complete overhauls of centrifugal pumps touch upon the controversial. It is difficult, if not impossible, to make general rules which would apply in all cases. The type of service for which the pump is intended, the general construction of the pump, the liquid handled, the materials used, the average operating time of the pump and the economic evaluation of overhaul costs versus possible power savings from renewed clearances, all these factors enter in some degree or another in the decision on the frequency of complete overhauls. Thus, some pumps on severe service may need a complete overhaul monthly, while other applications require overhauls only every two to four years or even less often. As a result, statements on the recommended frequency of complete overhauls may be quite correct in the light of the service under consideration, but could be easily challenged by an operator who has an entirely different application in mind.

Most pump designers and specialists consider that a centrifugal pump need not be opened for inspection unless evidence, of either factual or circumstantial nature, is available to indicate that overhaul is necessary. There are obviously some exceptions to this rule and these will be covered.

By factual evidence we mean that the pump performance has fallen off sufficiently or that noise or driver overload indicates trouble. In this connection, it should be noted that proper instrumentation is of paramount importance to the satisfactory operation and life of centrifugal pumping equipment. Means for determining pump capacities and pressures should be considered as part and parcel of the maintenance tools without which no operating engineer should consider running his plant.

A schedule should be set up for a frequent test of the pumping unit, so that the results of this test may be compared to the performance of the pump in its initial condition. If this is done, any sudden falling off in performance can be detected without delay. This comparison and not a mere passage of a fixed number of years, months, days and hours should be relied upon to establish whether or not sufficient internal wear has taken place to require a complete overhaul. Running a complete test is less expensive than opening up a pump for inspection, and it does not require taking the unit out of service.

To be able to evaluate the effect of extended operation on the life of a centrifugal pump, it is essential to understand the manner in which internal wear takes place and the effect of this wear on the pump performance. Two separate causes lead to increased internal clearances. The erosive action of the net liquid flowing past the wearing rings and various other internal running clearances causes part of the wear at all internal clearance joints. Another portion is caused by infrequent momentary contacts which may occur on relatively rare occasions during pump operation.

Pump Wear

No matter how rigidly a pump is designed, certain conditions may arise during abnormal operation (such as cavitation, loss of prime, or sudden hydraulic shocks) that impose a momentary vibration on the rotating element sufficient to cause a slight contact at the running joints. Wear will occur through the rubbing action of two metal parts, even though the contact may remain too slight to cause galling and seizure of the rotor in the stationary parts. A similar condition may exist if the shaft deflection under stationary conditions exceeds the internal clearances. This can occur even though the deflection is reduced to less than the running clearance by the supportive action of internal clearance joints acting as additional steadying bearings, lubricated by the liquid pumped. In these cases, a slight amount of wear will occur every time the pump starts.

It is impossible to state the exact amount of wear attributable to erosion and that caused by momentary contacts. But it is obvious that the more rigid the pump construction, the less cause there will be to expect wear through contact at the running clearances.

As running clearances increase with wear, a greater portion of the gross capacity of the pump is short-circuited through the clearances and has to be repumped again. The effective or net capacity delivered by the pump against a given head is reduced by an amount equal to the increase in leakage. While in theory the leakage varies with the square root of the differential pressure across running joints — hence with the square root of the total head — it is sufficiently accurate to assume that the increase in leakage remains constant at all heads. Figure 1 shows the effect of increased leakage of

the head-capacity curve. Subtracting the additional internal leakage, d_1, from the initial capacity at each head gives a new head-capacity curve as shown in Fig. 1.

It should be obvious by now that a certain amount of capacity margin should always be included in the design capacity to make up for the expected reduction in capacity caused by wear of internal clearances. The decision on when to overhaul a pump depends, therefore, on the amount of margin initially included in the pump selection and on the evaluation of the reduced economy against the cost of the overhaul.

In addition to the evidence given by a performance test on a centrifugal pump which has been operating for a certain period of time, there is also factual evidence in the form of noise, driver overload, excessive bearing temperatures and similar manifestations of trouble. All of these are too obvious in character to require further explanation.

Circumstantial evidence, which might indicate that a complete overhaul may be necessary, refers to data accumulated through past experience, either with the pump in question or with similar equipment on similar service. For instance, if a group of boiler feed pumps built of chrome stainless alloys has shown that 80,000 hours of continuous service can be accumulated without the need of a complete overhaul, an additional duplicate unit need not be opened for inspection before it has in turn run up a record of 80,000 hours.

On the other hand, pumps on severe service which have required overhaul at three months intervals may be replaced by units built of better materials or of sturdier construction. Nevertheless, until such time that the new equipment has proved itself in service and a new "experience pattern" has been established, it is best to open up the pump at the end of the same three months period in order to evaluate the effect of the better construction or better materials.

One of the exceptions which was mentioned earlier is related to corrosion-erosion troubles which will not necessarily be immediately reflected in the performance characteristics of the pump obtained by means of routine tests. However, if these troubles are permitted to continue unattended, they may easily result in the destruction of the pump, beyond any possibility of repair. But corrosion-erosion troubles are generally foreseeable. For instance, a pump handling corrosive chemicals and which is built of ordinary materials or of materials untested in that particular application may become rapidly and severely damaged. In such a case, it is advisable that the pump be opened for inspection fairly soon after initial installation and at frequent intervals thereafter, until such time that the life of the pump materials under the actual operating conditions has been determined.

The other important exception refers to a condition where the operator prefers to rely on visual examination and actual measurement of clearances. He may feel insecure unless he carries out such examinations at intervals which he has established in his own mind. If the operator cannot be shown proof that this procedure is unnecessary, the exception is fully warranted because without the visual evidence the operator may lack confidence in his equipment and this situation is not a healthy one. Rules were made to be broken and the well-being and confidence of the operator are much more important than the fact that a piece of equipment has been dismantled one or two extra times during its useful life.

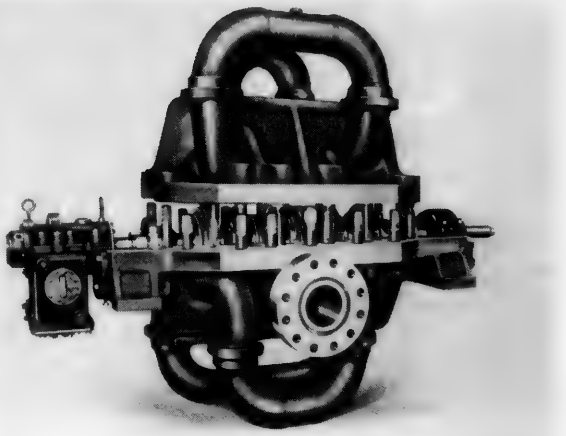


Fig. 2. The upper half of axially split casings must be lifted straight up so as not to damage the internal parts.

An important warning should be added: To insure rapid restoration to service in the event of an unexpected overhaul, an adequate store of spare parts should be maintained at all times. This will avoid possible delays in obtaining special repair parts from the manufacturer.

Complete Dismantling of a Centrifugal Pump

Great care should be exercised in the dismantling operation. Close suction and discharge valves and drain the pump casing. Take apart all necessary piping and parts which would interfere with the disassembly of the pump, such as bearing covers, as may be required in accordance with the manufacturer's instructions.

In the case of axially split casing pumps, after the dowels and the nuts of the casing bolts have been removed, the upper half of the casing should be lifted straight up, so as not to damage the internal parts. See Fig. 2. The rotor should likewise be removed vertically, to prevent injury to the impellers, wearing rings and other parts.

As the pump and rotor are dismantled, precaution must be taken to mark the various parts removed so as to insure proper reassembly. All individual parts and all important joints should be carefully examined. If the pump has been operating satisfactorily with only a slight reduction in head and capacity due to increased leakage, a decision on reconditioning will depend on the following factors:

1. Availability of spare parts.
2. Length of time the pump can be left out of service.
3. Economic considerations and importance of getting the greatest service from the unit without overhauls.

As a general rule, regardless of the performance of the unit, parts appreciably worn should be renewed, if it is not intended to examine the pump until the next routine period. One must remember that when parts with metal seats in new or good condition are assembled in contact with dirty or worn parts, the new parts are very likely to wear out rapidly.

The next article of this series will examine various practices followed in the maintenance of individual pump parts.

Johns-Manville Transite Pipe Plant, Denison, Tex., produces asbestos-cement pipe in continuous, automatic process.

Locker Room Atmosphere Improved

By Exhausting through Employee Lockers

THE new Johns-Manville Transite pipe plant, shown above, began operations at Denison, Tex., on June 20, 1958. Said to be the most modern of its type in the industry, it consists of five, one-story steel, concrete and corrugated Transite buildings on a 469-acre tract. The location is about four miles north of Denison on the banks of the Red River which separates Texas from Oklahoma. Adjoining the 1300-mile, man-made Lake Texoma, ninth largest reservoir in the world, the plant will fill the needs of the rapidly-growing southwest for pipe products: pressure pipe for municipal and private water systems, irrigation and industrial pipe lines, building and sewer pipe, air conditioning and other ducts, vents, stacks, and electrical conduits.

Among the facilities provided to maintain pleasant working conditions, are well-ventilated locker rooms in which much of the exhaust air is taken through the lockers. Figure 1 shows the exhaust locker header details.

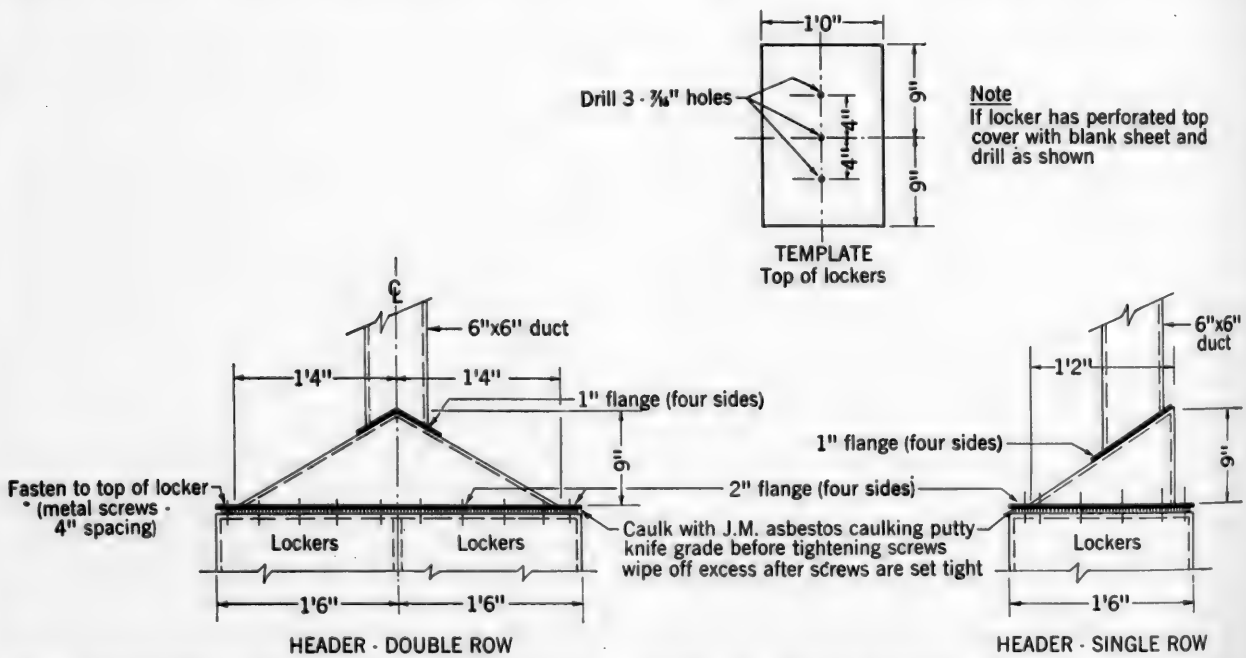


Fig. 1. Exhaust locker header details. Three cubic feet per minute are exhausted through each locker. A damper, as shown in Fig. 2, is installed in each of the 6-inch square ducts that exhaust from the locker headers. Details taken from drawings by The Austin Co., Houston, Tex., engineers and builders.

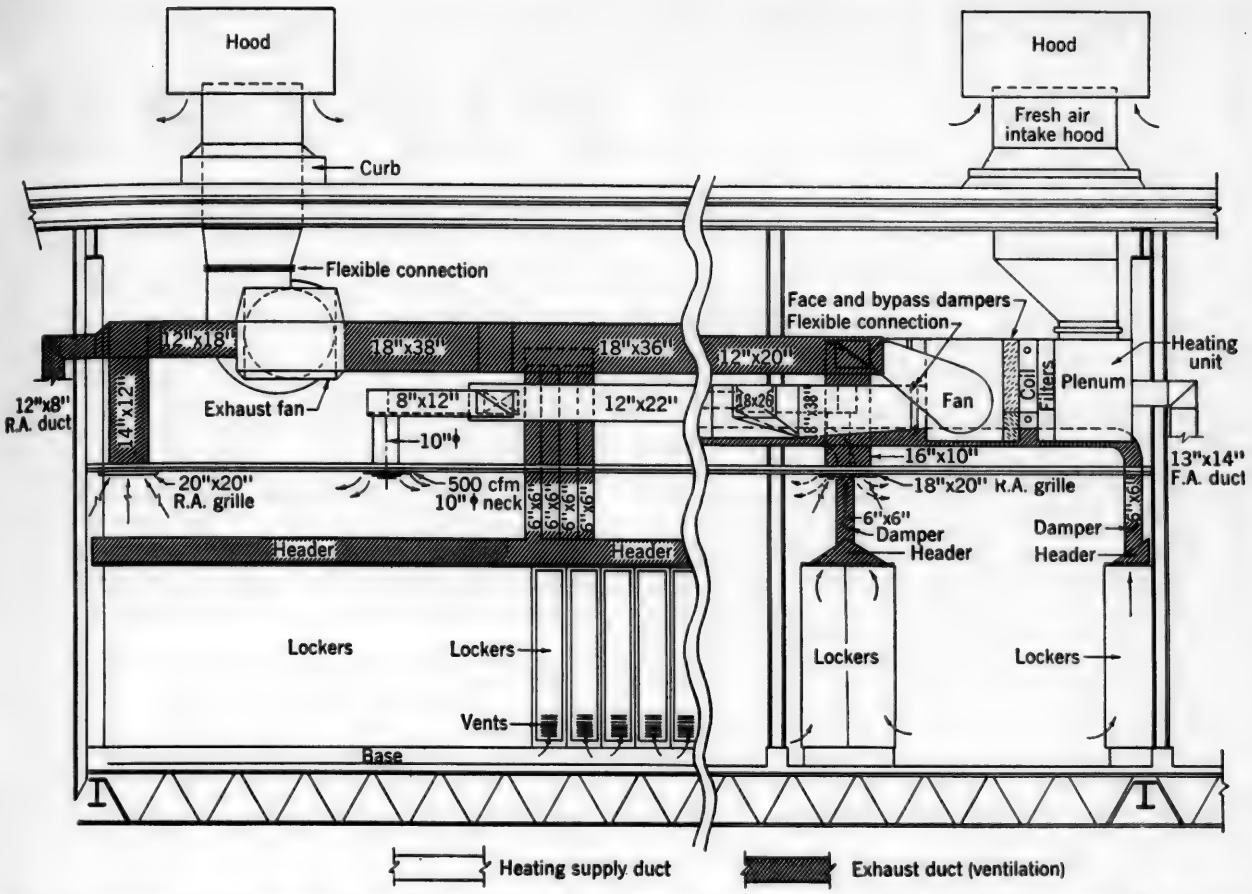


Fig. 2. Heating and ventilating system for locker rooms, showing exhaust through lockers. Two portions of the original drawings by The Austin Co., Houston, Tex., were selected to show front of one set of lockers, profile of others.

Figure 2, part of the heating and ventilating drawings prepared by The Austin Co., Houston, Tex., engineers and builders, shows how the locker headers are incorporated into the ventilating system.

Lockers are mounted on elevated concrete bases set on top of a 1-inch hard concrete and tile surface. Change rooms, equipped with conventional Bradley basins, have a 6-inch high curb all around to facilitate cleaning.

Basis of Design

The heating and ventilating system is based on a year-round 100% fresh air intake, providing 30 cfm per person in relief areas and 20 air changes per hour in toilet areas. Twelve air changes per hour are provided for the showers, and 3 cfm is exhausted through each locker.

Steam is supplied to the heating coil shown in Fig. 2. Exhaust fan blows 7270 cfm against ¼-inch SP.

New Data on Magnesia and Silica Insulation

The Engineering and Research Committee of The Magnesia-Silica Insulation Manufacturers Association has issued new industry data giving typical average values on physical and thermal properties of 85% magnesia, calcium silicate and diatomaceous silica insulations. The data are offered as a basis for engineering calculations on these materials.

Maximum service temperature for 85% magnesia is 600 deg F; average density, 11 lb per cu ft. For calcium silicate, 1200 deg and 12 lb per cu ft are given.

A portion of these data on the typical physical and thermal properties for all four products are given in the accompanying table. Individual manufacturers should be consulted for their particular products' properties where more exact data is required, the Committee advises.

PROPERTIES OF MAGNESIA-SILICA INSULATION

	85% Magnesia	Calcium Silicate	Diatomaceous Silicas	
	Maximum Service Temperature, Deg F			
	600	1200	1600	1900
Mean Temp. Deg F	Average Conductivity, Btu-Inch per Hr/Sq Ft/Deg F			
100	0.35	0.32	—	—
200	0.38	0.37	—	—
300	0.42	0.42	—	—
400	0.46	0.46	0.64	0.69
500	—	0.51	0.66	0.71
600	—	0.56	0.68	0.73
700	—	0.61	0.70	0.75
800	—	—	0.72	0.78

LOUIS BLENDERMANN ON

PIPING AND PLUMBING

Fresh Air Inlets

A FRESH air inlet is a vital part of the building sanitary system. Its prime function is to permit the entry of air into the lowest part of the sanitary system. This air circulates through the sanitary piping system and discharges at the vent stack terminal at the roof level. Such circulation of air keeps the piping system free of odors and prevents the accumulation of harmful, explosive sewer gases. Figure 1 shows a typical sanitary system and general location where the fresh air inlet is placed.

Referring to Fig. 1, note how the fresh air inlet and piping is placed at the low point in the sanitary system.

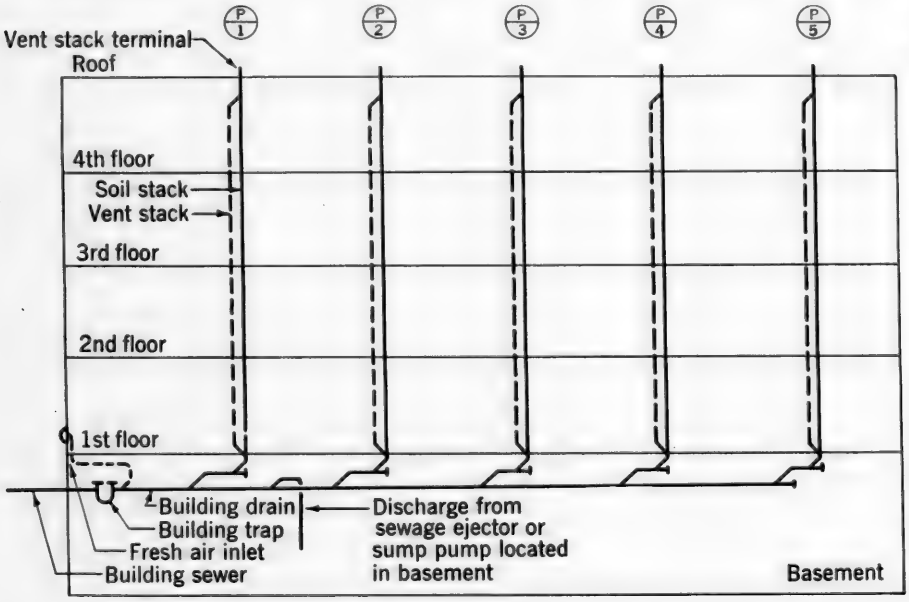


Fig. 1 (left). Sketch showing location of fresh air inlets on a typical building sanitary system.

Should excessive pressure in the street sewer force gases through the water trap seal in the running trap, such gases will be vented through the fresh air inlet piping rather than accumulate elsewhere in the building sanitary system. The purpose of this article will be to show how this component of the sanitary system is usually installed and the different types of devices that are available for this application.

It might be mentioned here that the installation of the fresh air inlet is not required in all areas of the country since, in many areas, the exterior street sewers are vented by means of the vertical vent stacks in the building. Numerous other reasons of a local nature also account for the reason why the fresh air inlets are not required in many areas. However, since the fresh air inlet is widely used in most parts of the country, its discussion here is worth while.

The fresh air inlet may be utilized with the sanitary system in all types of buildings or structures. The engineer should always consult with the local plumbing authorities in the area where the proposed building is to be erected to ascertain whether a fresh air inlet must be included with his design of the sanitary system.

Private Residences

Fresh air inlets are used in all types of buildings, large

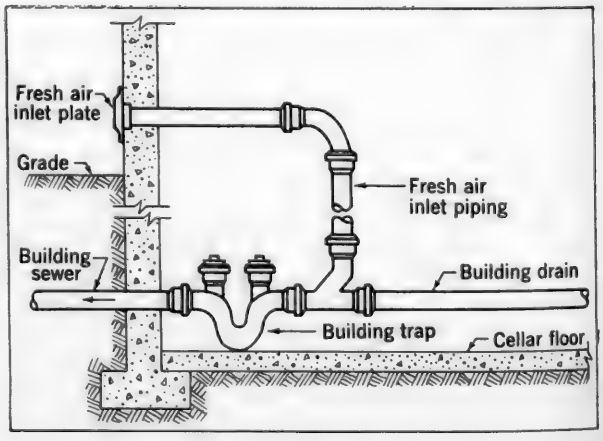


Fig. 2 (below). Typical arrangements of fresh air inlet piping in a private residence where the drain is located above the cellar floor.

and small. For a private residence the fresh air inlet would be similar to that shown in Fig. 2.

In Fig. 2, the building drain is shown as being located above the cellar floor as it is in many of the new homes. The elevation of the street sewer normally determines the location where the building drain is located in the building. If the building drain were located below the cellar floor, the arrangement of the fresh air inlet piping would be similar to that as shown. The fresh air inlet plate in this instance is generally placed between 12 and 24 inches above the grade. In fact, this placement is rather general for the wall plate in all types of buildings.

Inlet for Tall Buildings

Figure 3 portrays fresh air inlet piping as it may be installed in larger buildings where the ground floor of the building is set at grade level. In this case, the fresh air piping is connected to the building drain at a point outside of the concrete pit as shown. If desired, the connection can of course, be included inside of a larger pit. Both Fig. 1 and Fig. 2 have been included as examples only, to show how the installation can be accomplished.

Tall Buildings

Tall buildings usually include a cellar, sub-cellar and sometimes even an additional cellar. Figure 4 represents a typical arrangement of the fresh air inlet piping for such an installation.

Threaded piping has been used for both the building drain and the fresh air piping in this detail. However, the engineer may specify any particular type of piping he favors for this installation. Arrangements of piping other than that shown may also be used as the requirements demand. Sleeves are usually provided in the floor slab for the passage of the piping. Although the piping is shown to be exposed above the ground floor level, it is concealed by the interior wall construction which has not been shown in the illustration.

Piping Materials

There are a number of different piping materials that are approved for use in a sanitary system. These include cast iron, galvanized steel, galvanized wrought iron, copper, or other materials that may be accepted for use in a given area. The fittings in all cases should be the drainage pattern type.

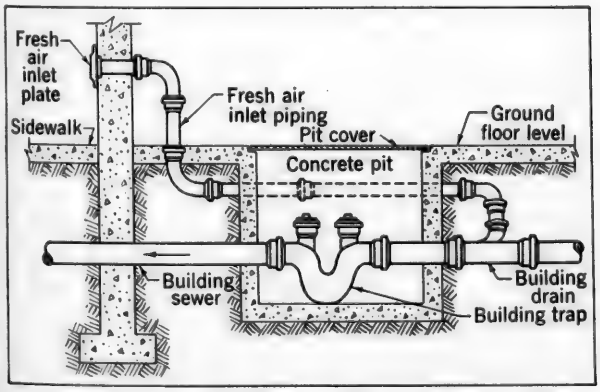


Fig. 3. Typical arrangement of fresh air inlet piping in a larger building where the ground floor of the building is set at grade level.

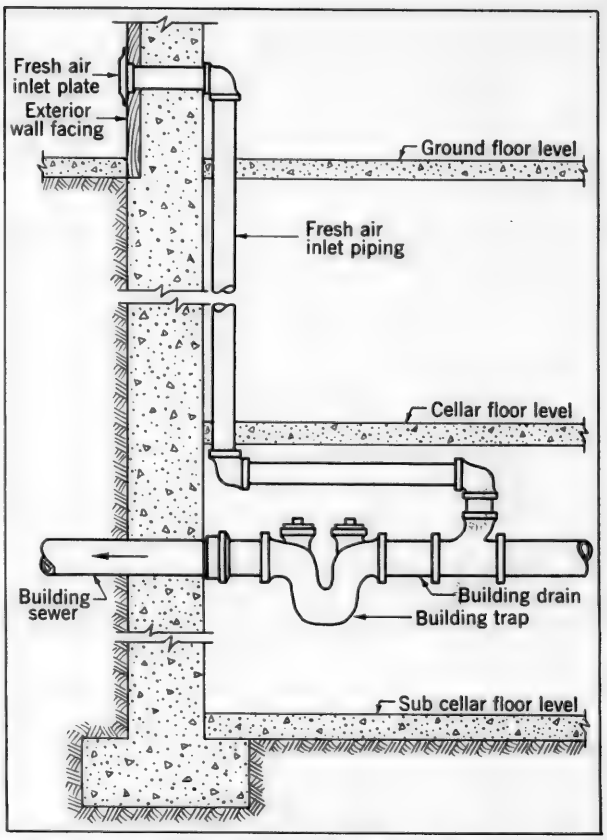


Fig. 4. Typical arrangement of fresh air inlet piping in a tall building.

Size of Piping

In general, the fresh air inlet piping should be at least one half the diameter of the building drain to which it is connected. The fresh air piping is never less than 4 inches in diameter with the exception of those specific areas where smaller diameter piping is permitted.

Inlet Plates and Terminals

There are a number of different types of fresh air inlet plates or terminals available on the market from which the engineer may select. The effective open area of a fresh air inlet plate or terminal should be at least equal in area to that of the inlet piping to which it is connected. In the majority of cases these devices are usually sized to be in excess of the effective area of the piping connected to the unit.

The wall plates or terminals have two purposes. First, by virtue of their particular style or shape, they prevent foreign objects from being placed into the piping. Second reason, the wall plate or terminal offers a decorative termination of the fresh air inlet piping.

Wall plates and terminals are available in a number of different material finishes, including, bronze, polished bronze, bronze alloys, chrome plated, aluminum, stainless steel, and several other finishes.

Wall Plates

Numerous types of wall plates are obtainable, three of which are illustrated in Fig. 5.

Type *A* (Fig. 5) is a threaded wall plate which engages the threaded piping that projects through the exterior

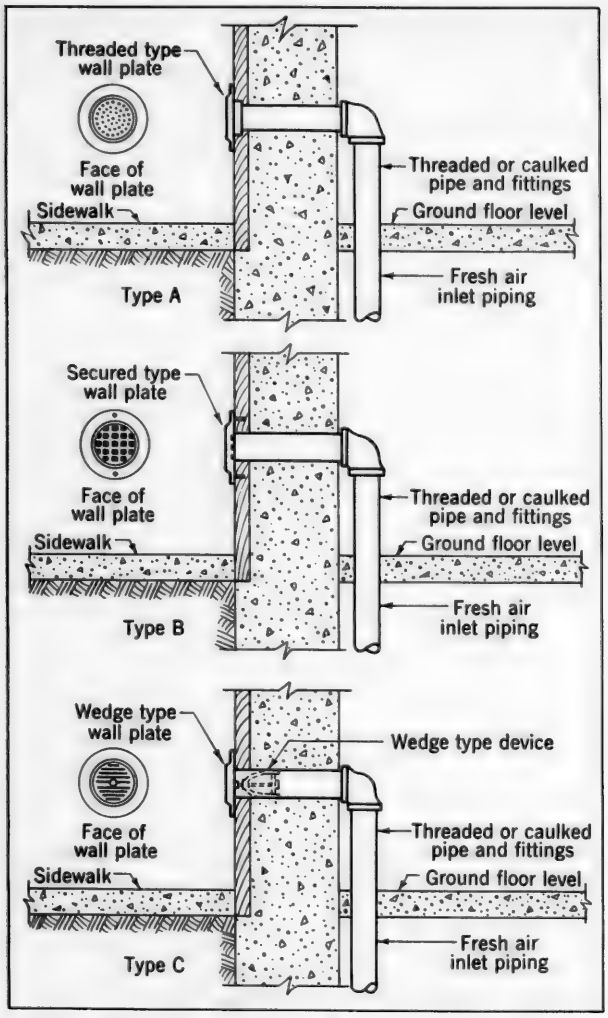


Fig. 5. Three types of wall plates for fresh air inlets.

wall. After the exterior facing of the building has been applied, this wall plate is installed.

Type *B* is a wall plate that is secured to the exterior wall facing. After the wall facing has been applied and the piping installed, holes are drilled in the facing into which anchor devices are inserted. Screws are then used to secure the wall plate. This type of wall plate does not engage the piping but merely butts up against it.

Type *C* is that type of a wall plate that is secured by a wedge placed in the fresh air piping. After the exterior wall facing is applied and the piping installed, a wedge device of which there are several types, is placed into the piping. As a nut is tightened on this device, the device expands in the piping. The wall plate is then added and is secured by a screw which engages a rod that is included with the wedge type device.

In addition to the wall plates illustrated in Fig. 5, there are other types that may also be used. Wall face plates with round, square and slotted openings have been shown in Fig. 5, to indicate the range of different style face plates that are available for this purpose.

Standing Type Inlets

Quite often standing type fresh air inlet terminals are required for a particular installation. Two of such devices are shown in Fig. 6.

Method 1 in Fig. 6 shows a standing type unit that is installed on the sidewalk in front of the building. This type of device is used when the engineer does not wish to penetrate the floor slab or exterior wall of the building with the fresh air inlet piping. In this instance, the terminal device is threaded to engage the piping. In addition, the unit may be secured to the sidewalk by anchors and bolts.

This type unit may be had in a number of different material finishes depending upon the specific type desired. Furthermore, it presents a neat appearance.

Method 2 (Fig. 6) shows a regular dome type standing fresh air inlet terminal. This unit is of cast iron and the dome is attached by a securing screw. The device is caulked into the underground piping, as shown. This type of arrangement is usually employed for grade conditions at the exterior of the building. The hub of the underground piping is encased in concrete to anchor this piping in place.

In addition to the arrangements shown in Methods 1 and 2, other similar hook-ups and devices may also be used with equal success.

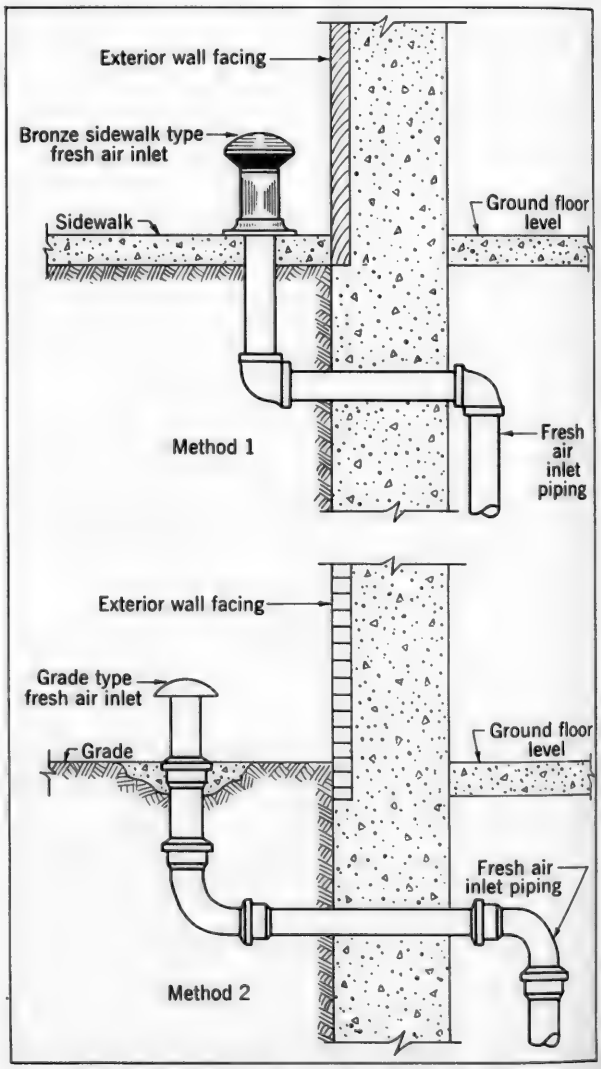


Fig. 6. Two types of standing fresh air inlets.

Exterior Trap Pits

There are occasions where the building trap will be located outside of a building. An installation of this type would be similar to that shown in Fig. 7.

In Fig. 7 the running trap is placed in a concrete pit outside the building. The fresh air inlet piping is included right in the pit and extends up through the cover to terminate at a return bend set above the pit. Instead of the return bend, standing type fresh air terminals, as shown in Fig. 6, can also be used.

The fresh air inlet piping is secured to the side of the pit to hold it in a vertical position. If watertightness is required at the pit cover it can be accomplished by means of a rubber sleeve placed over the fresh air piping where it protrudes through the cover. When carefully installed, this arrangement will afford the adequate means of a fresh air inlet.

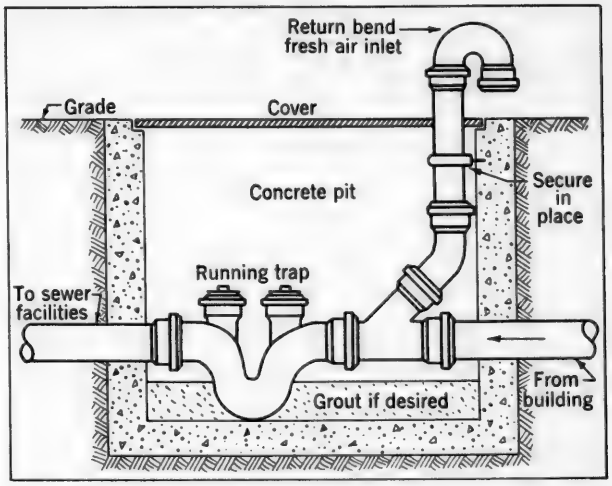


Fig. 7. Typical arrangement of a fresh air inlet for a trap located outside of the building.

Special Devices

For wall plates that are placed at the exterior face of a building, there are also available devices that include a flapper to prevent odors from being discharged out of the wall plate when a heavy flow of sewage is passing through the running trap on its way to the street sewer. The flow of waste will force the air out of its way and force it through the wall plate. Such odors discharging at the sidewalk level can, of course, be quite objectionable to persons passing by.

Determination of Acetylene in Low Concentrations

A rapid, accurate, colorimetric method for detecting and measuring minute quantities of acetylene in air has been developed by the National Bureau of Standards in cooperation with the U. S. Public Health Service. Since acetylene in the air is associated with the contaminants from automobile exhaust gases, the method is expected to be useful in the study and monitoring of urban air pollution. The process, developed by E. E. Hughes and R. Gorden, Jr., of the Bureau's gas analysis laboratory, permits detection of acetylene concentrations as low as 10 parts per billion. The equipment required is simple and portable, so the method is well suited for field studies.

The first step in the procedure is to concentrate a measurable amount of the dispersed acetylene by absorption on silica gel. The quantity of acetylene present is indicated by the depth of color produced when the silica gel surface is treated with a solution of ammoniacal cuprous chloride. Then the exact concentration is determined by visually comparing this color with those produced by gas samples containing known concentrations of acetylene.

A normal urban atmosphere contains a wide variety of gaseous inorganic and organic contaminants. These come mainly from industrial processes and vehicles. The internal combustion engine is a major source of the organic contaminants.

The development of rapid procedures for the qualitative or quantitative determinations of such substances has become of great importance for the early detection of changes in pollution patterns of certain areas. In particular, the analysis of certain substances—such as acetylene—which have been found in relatively constant concentrations in traffic gas, serves as a simple and practical means of determining the degree of contamination in the air.

Besides its use in the study of air pollution, this method can be applied to other industrial or laboratory processes requiring the determination and fractionation of air constituents. For example, accumulation of solid acetylene in liquid air generators has caused numerous costly and dangerous accidents. Although the permissible level of acetylene in the intake air is quite low, the amount of gas can easily be detected by this procedure.

To begin the determination, a definite volume of air contaminated with the acetylene is drawn through a long, small-diameter glass tube containing highly purified silica gel. As the air sample passes through the tube, which has been cooled to the temperature of dry ice, acetylene is absorbed on the gel's surface. A column of fine glass beads bounds the gel layer at each end of the tube, making possible easier detection of slight color changes. Because the acetylene collects mainly on the initial portion of the gel, the tube is allowed to warm to room temperature for a short time to obtain a homogeneous distribution. An ammoniacal solution of cuprous chloride, obtained by mixing a solution of ammoniacal cupric chloride with hydroxylamine hydrochloride, is then introduced into the tube and the copper acetylide formed precipitates directly on the gel surface. The resulting color ranges from pink to brown, depending on the quantity of acetylene and the specific color fixes the acetylene concentration.

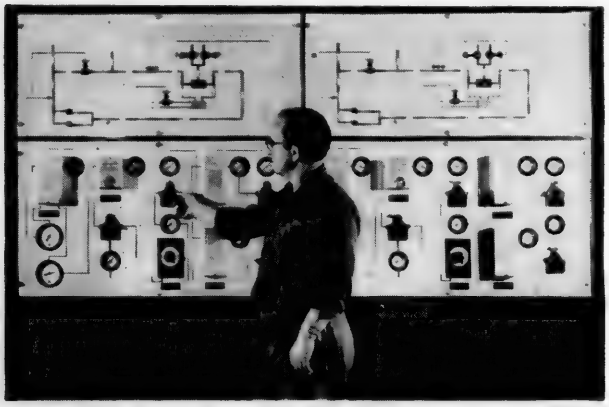
When the concentration of acetylene in the atmosphere is 10 ppm or above, detectable quantities can be absorbed at room temperature. At concentrations below 10 ppm, the gel must be cooled to −78 deg C, the temperature of dry ice. Because of increased absorption at this temperature, it has been possible to detect concentrations as low as 10 parts per billion.

PRODUCT APPLICATIONS

New, Unusual, or Ingenious Uses of Equipment and Materials

Air Conditioning Efficiency Aided By Graphic Control Panels

Graphic control panels incorporated into the pneumatic control system help simplify air conditioning operations in New York's Seagram Building. Each of the building's 23 central fan systems and four chilled water systems has its own individual panel installed adjacent to the system. Each panel contains a color-keyed symbolic



graphic representation of the particular system as well as control instruments, thermometers, pressure gages and related aids for the engineer.

According to engineers of the Johnson Service Co., Milwaukee, Wis., which furnished the pneumatic control system, the use of graphic panels helps to eliminate errors and boost efficiency by giving building personnel a clear understanding of each system and its operation. They also point out that grouping controls and indicators is both a convenience and a time saver, and results in better supervision.

Conditioned air for perimeter offices of the Seagram Building is supplied by a 3200 unit induction system; high pressure dual duct systems serve the interior zones. All offices are individually controlled.

Burning Waste Paper for Steam Generation Reduces Air Conditioning Costs

Burning waste paper for steam generation is saving Alexander's Department Store in White Plains, N. Y., $2-thousand per year in fuel costs alone. The large 4-story building, opened in November, 1956, is completely air conditioned by a 700-ton steam-operated central unit. The heat from the burning waste paper supplies up to 30% of the total steam required for peak operation. During spring and autumn when air conditioning demands are low, the waste heat boiler furnishes all of the steam needed to air condition the store.

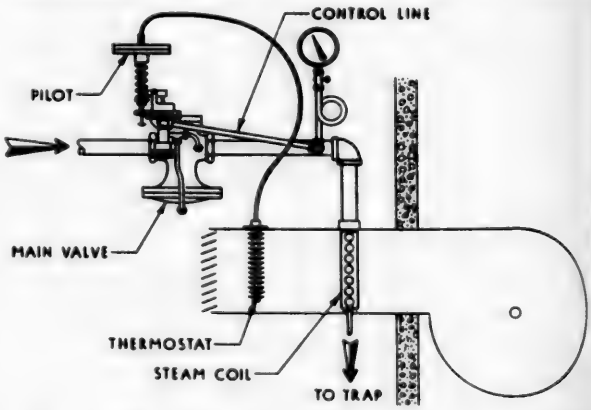
The waste heat utilization system consists of the incinerator, with capacity for burning up to 800 lb refuse per hour, the waste heat fire tube boiler rated at 4000 lb steam per hour, and an ingenious system of ducts, dampers, and controls. An essential part of the system is the mechanical draft inducer made by the L. J. Wing Manufacturing Co. When the system is operating at full load, the stack does not supply enough draft to draw the hot gases from the incinerator through the boiler. The consulting mechanical engineers, Syska & Hennessey, were limited in the stack height by architectural considerations. Therefore, they specified a mechanical inducer so that the chimney or stack height would conform to the building design and combustion would always be complete.

At start-up the draft inducer is turned on, and the incinerator is loaded. A gas burner helps to start burning as well as reduce fly ash. The gases from the incinerator are drawn through the boiler and exhausted through the stack to the atmosphere. The first 20-30% of the total steam demand is handled by the waste heat boiler. When the demand rises above the capacity of the waste heat boiler, a separate oil-fired boiler, rated at 13,100 lb steam per hr, is automatically lighted off to supply the balance of the steam required.

Make-Up Air Temperature Controlled By Combination Regulator

Assume that it is required to provide control of the temperature of make-up air with varying outdoor air temperatures.

A solution would be use of Type ET150 regulator, manufactured by Spence Engineering Co., Inc., Walden,



N. Y., which combines the functions of a reducing valve and temperature regulator. A maximum coil pressure is set on the pressure control of the pilot sufficient to heat incoming air to the desired temperature at the lowest outdoor temperatures. The thermostat element, as illustrated, then throttles the pilot (and, therefore, the main valve) to maintain a constant outlet air temperature.

Airport Heating, Air Conditioning Costs Determined by Btu Meter

New York International Airport (Idlewild) will operate on a decentralized basis through a number of separate terminals. Various services will be supplied by the airport operator, The Port of New York Authority. One such service will be high temperature hot water for heating and chilled water for air conditioning.

Two Pollux Btu meters, furnished by Air Conditioning Equipment Corp., of New York, have been installed in the Port Authority's Operations Building to show the Authority how much it is costing to heat and cool its own building. These meters, one for chilled water and the other for high temperature water, record directly in Btu the amount of heat or refrigeration actually used in the building.

The Btu meter consists of a liquid meter, an integrator and two temperature sensing bulbs. One of these bulbs is placed in the supply main and the other in the return main. The liquid meter in the HTW system, illustrated, is generally placed in the return line and the chilled water meter may be placed in the supply or the return line, depending upon the conditions specified by the engineer. The difference in temperature between the water in the supply and return is multiplied mechanically by the integrator with the flow of water which has been converted to weight. The result in Btu is shown cumulatively on a digital counter on the face of the meter. In addition to the total Btu, instantaneous temperature difference is indicated (to facilitate trouble-spotting), and the gallons of water are shown cumulatively. The Btu consumed is read from the meter at regular intervals, and a charge is made on this basis.

32-Mile Emergency Pipe Line Put in Deep Freeze

During the severe drought in the Midwest several years ago, two cities in Kansas, Augusta and El Dorado, were faced with the possibility of being completely without water. Possible disaster was averted by an outstanding example of co-operation between local industry and civic groups. Three local oil refineries, Skelly, Socony Mobil and El Reco, and the two threatened cities banded together to form the Augusta-El Dorado Water Association. The association quickly raised $1.6-million to lay an emergency pipe line. In the record time of 30 days, a 32-mile pipe line was laid from the Arkansas River along a right-of-way donated by the Santa Fe Railroad. Connections were then made to the distribution lines in the three refineries and two cities.

Although the emergency eventually passed, it was decided to maintain the pipe line as protection against possible future water shortages. Engineers of Linde Company, Division of Union Carbide Corp., helped to provide a unique and highly effective method of preventing internal corrosion in the line. The entire length of the 32-mile pipe line was filled with gaseous nitrogen and sealed off at both ends. The nitrogen served a dual purpose. It purged water and air out of the line and remained in the line as a "blanketing" agent, preventing future corrosion by keeping oxygen out.

Plastic Hoods in Exhaust System Avoid Obstruction of Light

The Connecticut General Life Insurance Co., of Hartford, Connecticut, has recently installed an exhaust and dust collecting system in its printing room to confine the offset spraying operation. This is a common installation and has proven to be effective in eliminating the messy clean-up problem of the fine starch dust. The exhaust hoods which fit over the printing presses are elaborate and must be carefully designed for efficient operation.

Sometimes these hoods, however, overshadow the presses in such a way that they create a lighting problem. Connecticut General solved this problem uniquely by installing Plexiglas hoods, as shown in photo. The transparent material avoids obstruction of both light and visibility, and also makes a clean and attractive installation.

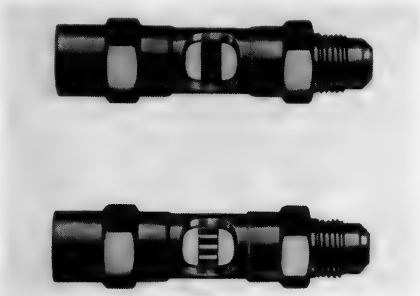
Printing presses are exhausted by Type W Roto-Clone dynamic precipitators, manufactured by American Air Filter Co. These precipitators combine the dual functions of exhauster and dust separator with a high effectiveness achieved through the use of water sprays. They deliver the collected starch dust in the form of slurry for convenient disposal, without creating a secondary dust problem.

NEWS OF EQUIPMENT AND MATERIALS

Use the convenient prepaid postcard appearing on the last page for securing additional information about new equipment and materials described in this department.

Simplified Moisture Indicator

Allin Manufacturing Co., Chicago, Ill., has developed a simplified, economical Moisture-Reactor unit which is built into the company's Liquid Eye indicators to detect the presence of moisture in F-12 and F-22 refrigerant systems. The Moisture-Reactor is composed of alternate, permanent and changing color bars. If there is



no moisture in the system, all the color bars will be green. But when there are alternate colors (green and yellow), this is the warning that moisture has entered the system, and dehydrator efficiency must be checked. When the line is moisture-free again, the color bars will change back to their original solid green color.

This unit is positioned right in the center of the indicator viewing ports, as illustrated, directly in the refrigerant stream. There is no flow obstruction, and no sediment can lodge within the bars to obscure readings.

More information? Circle Item 1, postcard, last page.

Jet Pump Motors

A new line of 48- and 56-frame jet pump motors designed especially for operation of water system centrifugal- or ejector-type pumps is available from Westinghouse Electric Corp., Pittsburgh, Pa. Termed Jet-Line, motors have round frames with NEMA standardized 56C faces for direct pump mounting and are equipped with grease-lubricated ball bearings designed for vertical or horizontal mounting.

Available in split-phase, capacitor-start and polyphase models, units are rated either ⅓ or ½ hp in the 48 frame. They come with single or dual voltage, either 2850 or 3450 rpm. Dual-voltage motors have spade connectors for ease in changing voltage. Unit construction, featuring a locked-bearing design, permits removal of the end shields without damage to bearings and shaft bearing surfaces or disturbance of motor wires or connections.

All motors have a drilled and tapped hole in the bracket opposite the shaft extension for mounting a drip cover. An extra large conduit box with threaded conduit hole is used. Mylar polyester film, laminated to a high-grade electrical insulating paper, is used throughout for slot and phase insulation. Stators are dipped in a moisture-resistant thermosetting varnish and baked, to insure total moisture protection.

More information? Circle Item 2, postcard, last page.

Liquid Level Controls

Two liquid level controls are offered for use where a top-mounted control with a flanged or screwed mounting can be employed. An addition to the line of Magnetrol, Inc., Chicago, Ill., the new models will control either pumps or automatic valves.

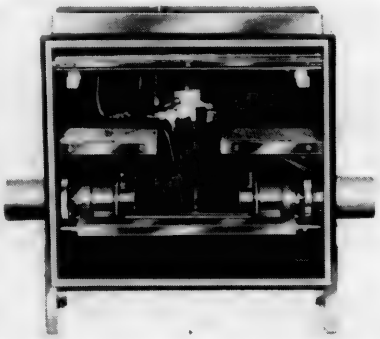
The models—designated A-102-F (illustrated) and A-103-F for flanged mounting, and A-102 and A-103 for screwed mounting—are for wide differential applications. Since *differential* in the company's terminology means the amount of liquid level travel between *make* or *break* on a single switch, they are especially suited for pump control to either fill or empty tanks.

Specific gravity ranges for the models begin at 0.5, depending on the type displacers used and the operating temperature of the liquid being controlled.

More information? Circle Item 3, postcard, last page.

Constant Volume Device Added

Air Devices Inc., New York, N.Y., announces addition to its Thermotank perimeter and ceiling high velocity mixing boxes a device called Con-Vol, meaning constant volume under all conditions.



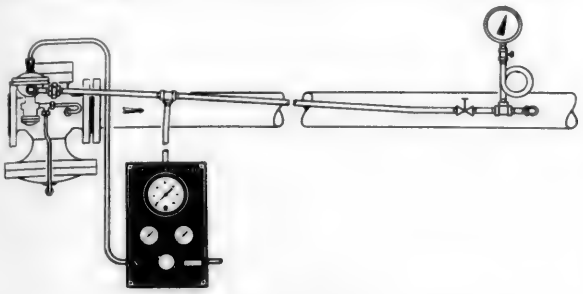
The unit is said by the company to assure precision control of air volume and temperature over a wide range of varying inlet pressures without the use of linkage or complicated operating mechanism.

More information? Circle Item 4, postcard, last page.

Air-Loaded Pilots

Spence Engineering Co., Inc., Walden, N. Y., announces a new series of air-loaded pressure and temperature pilots for use with its standard line of main valves.

The air-loaded pilots are interchangeable with pilots of existing regulators. Adjustment of the air loading from



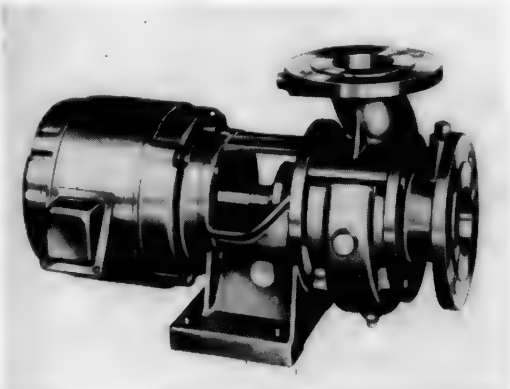
a remote control station permits easy adjustment of the control setting of the pilots.

An air control panel, shown in diagram, has been developed for use with these pilots, and includes supply and loading air gages, non-bleed air pressure control valve, and an optional delivery pressure gage.

More information? Circle Item 5, postcard, last page.

Standardized Centrifugal Pumps

A new line of standardized single-stage centrifugal pumps for heating, air conditioning and industrial applications, introduced by Taco Heaters, Inc., Cranston, R.I., is said to be the first line of pumps of this type to take advantage of preferred number standardization. Preferred numbers adopted by ASA have been introduced to standardize important linear dimensions and other pump characteristics.



Other features of these pumps, first of this type to be made by this company and based on Swiss designs, are listed as relatively few sizes to cover a broad range of performance; high efficiencies; interchangeability of parts; stuffing box or mechanical seals; rugged construction; and extra quiet motor.

By rotating the casing around the shaft center, the pump discharge can be placed in any position. Casings on this LP Series are the centerline discharge type which means there is no dimension between the centerline of the pump and the centerline of discharge to be concerned about. The discharge pipe is always located in the centerline of the pump. These pumps are self ventilating when installed in the normal position with the discharge up.

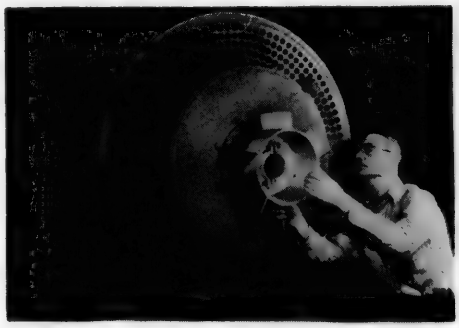
Cast iron or bronze impellers are available. Pumps are tested to 250 psi, statically and hydraulically balanced with double wear rings. Foot of the frame is located in about the center of the pump and equally supports weight of pump and motor. Pumps, presently available in 20 to 500 gpm, will eventually be produced in larger sizes.

More information? Circle Item 6, postcard, last page.

Fan-Cooled Motors

Tube-type totally enclosed fan-cooled squirrel-cage motors are offered in polyphase ratings through 500 hp by Wagner Electric Corp., St. Louis, Mo.

Efficient cooling is provided in these fabricated steel frame motors by a series of tubes, through which outside air is forced by an external blower. An internal blower



at each end of the rotor circulates the warm air inside the motor through ducts in the rotor and stator and around the cooling tubes, to hold temperature rise within the specified limit.

Photo shows a 400-hp fan-cooled tube-type motor with blower shield removed.

More information? Circle Item 7, postcard, last page.

All-Metal Air Filter

An all-metal air filter, with a life expectancy claimed by the manufacturer to be 20 years, is introduced by Viking Air Products, Cleveland, Ohio. Officially designated the Viking 20-Year air filter, this unit is reported to save as many as 40 replacements.

The copper media is said to surpass other types of filtering material because of its "air scoop" construction. It does not require coating and therefore, according to the manufacturer, vacuums clean easily.

A corrugated aluminum entry grid holds the media firmly in place and permits it to "depth load" so that the filter remains efficient for a longer period of time. The back of the filter is supported by a corrugated aluminum screen, and the edges are of precision formed aluminum channel.

More information? Circle Item 8, postcard, last page.

Mixed-Flow Air Impeller

A new design of mixed-flow air impellers is announced by The Torrington Manufacturing Co., Torrington, Conn. These impellers are designed to operate in the range of performance between axial fans and centrifugal blowers. Because most of the pressure conversion takes place within the blade passages, the performance is less dependent upon the specific housing configuration.

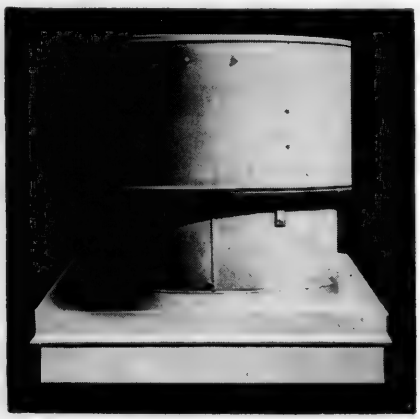
Application of these impellers in a typical room air conditioner has shown very substantial reductions in noise and fan motor power, the company reports. The space required by the new impellers is comparable with the space requirements of the more conventional impellers in common use today.

Type H mixed-flow impeller, illustrated, is composed of nineteen precisely-contoured blades mounted between a curved inlet ring and back plate. The blades at the intake edge resemble the blades of an axial impeller and at the discharge edge resemble the blades of a centrifugal impeller. The blending of these two features result in a complex, compound blade curvature. This impeller will initially be produced in four sizes to cover the flow range from approximately 150 to 800 cfm.

More information? Circle Item 9, postcard, last page.

Power Roof Ventilators

Upblast power roof ventilators offered by E. Van Noorden Co., Boston, Mass., feature a flat curb base which provides architecturally pleasing low silhouettes. Units provide high velocity, large capacity, vertical discharge to remove excessive heat, smoke, and fumes from



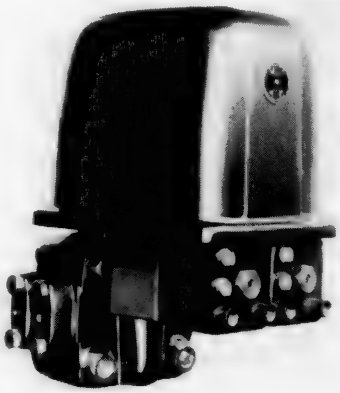
over furnaces, vats and tanks at rates up to 86,000 cfm.

A powerful fan action opens the dampers and provides rapid exhaust for efficient, low-cost ventilation under the most difficult conditions, the company states. Ventilators are designed to fit any flat or pitched roof. They are weathertight, and when power is on, high-velocity discharge keeps rain or snow out. When the power is off, the sloped dampers close tightly and any rain water is directed to the exterior through an intermediate drainage gutter. Twenty-six models are available to exhaust from 1,628 to 86,680 cfm.

More information? Circle Item 10, postcard, last page.

Force Balance Transmitters

A line of force balance transmitters which measure and pneumatically transmit flow, differential pressure, level, and specific gravity over wide ranges, is offered by Bailey Meter Co., Cleveland, Ohio. Transmitters measure over a minimum range span of 0-2 inches of water



under service pressures to 50 psig, to a maximum span of 0-2000 inches of water under service pressures to 5000 psig.

No viscous or other dampening devices are needed, the company states, stability being maintained by a newly developed reset type booster relay.

When a pneumatic signal, varying linearly with rate-of-flow, is required for recording on the same chart with other linear quantities, or for integrating, and/or control purposes, the transmitter has a built-in square root extractor. This eliminates the need for external square root extracting devices. Flow transmitter, which may be mounted directly on the process piping, is said to be useful as one element of a multi-element control system. Its linear rate-of-flow signal combines easily with pneumatic signals from other linear transmitters.

More information? Circle Item 11, postcard, last page.

Dust Arrestor

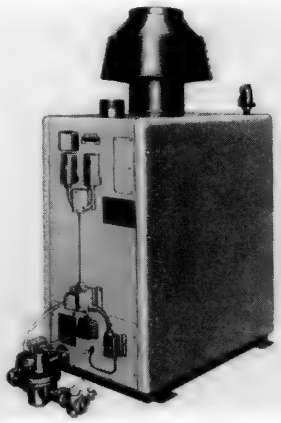
Formula No. 117, a product of Circle Chemical Co., Chicago, Ill., is described as an extremely high penetrating wetting agent employed to arrest dust in coal and aggregate handling operations. It is designed for efficient dust control when diluted one thousand times with water.

According to the company's announcement, they have been furnishing wetting agents for coal dust control to mid-western power plants for the past three years with excellent results. These wetting agents will now be made available to a much broader market.

More information? Circle Item 12, postcard, last page.

Copper Tube Boilers

Four new Bryan copper tube boilers, for large homes and commercial installations, have been announced by Bryan Steam Corp., Peru, Ind. These four units are known as Series 300 and are available in capacities of

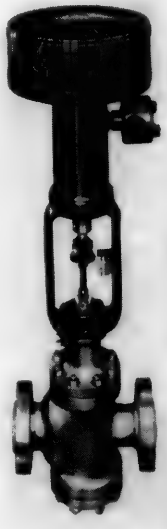


240,000 to 600,000 Btu per hr, with 1-inch OD tubes, gas or oil fired. A completely wired and assembled package is 27 inches wide. All units are built to the requirements of ASME and approved by AGA.

More information? Circle Item 13, postcard, last page.

Freon-Powered Activator

An actuator which utilizes the expansive force of Freon vapor to position valves and other final control elements is announced by Swartwout Co., Cleveland, Ohio. Called the Thermo-Drive Actuator, device uses no compressed air, motors, gear trains, pumps, oil, amplifiers, or relays of any kind. It develops a force of 500 lb, (opposed by a 300-lb return-spring force), gives a total stroke length of 1.5 inches, and a response speed of 0.1 inch per sec. Precise null-balance positioning is possible at any point within the limits of the actuator, the company states.



Operating principle is based on the controlled rate of heat release through Freon circulating in a closed chamber open only to a condenser. Within the Freon-filled chamber there is a heavy spring bellows coupled to an actuating stem and to a mechanical position-feedback device. Freon is continuously vaporized by an integral heater, creating a vapor pressure within the chamber. Control action is achieved by varying the bleed rate of the Freon into the condenser through a release valve. The release valve is operated by a force coil responding to a command signal from a control instrument. When the bleed rate is decreased, the vapor pressure increases, compressing the bellows and causing a downstroke. Conversely, an increase in the bleed rate will permit the bellows to expand, producing upstroke. Precise positioning of the stem is assured by the built-in feedback loop. Position repeatability is said to be accurate to 0.5%.

A rugged, hermetically-sealed unit, actuator is unaffected by ambient temperatures, line temperatures, radiant heat or adverse weather conditions. It is explosion proof, suitable for Division 1 locations.

More information? Circle Item 14, postcard, last page.

Duct Insulation Adhesives

Two duct insulation adhesives are available from Cain Manufacturing Co., Birmingham, Ala.

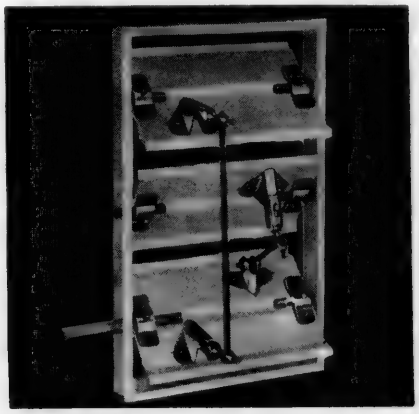
One, Fastak, is an adhesive formulated especially for bonding insulation to metal ducts. It is economical, yet contains all the qualities desired for an immediate, strong, and lasting bond, the company reports.

The other, Ductak, is designed for those who desire a slightly slower setting time as compared to the former adhesive. Both are available in 53-gal drums, 1- and 5-gal cans, and ½- and 1-qt cans for application by roller or brush.

More information? Circle Item 15, postcard, last page.

Damper Hardware

Development of damper hardware, named Ball-O-Matic, is announced by Elgen Mfg. Corp., Long Island City, N. Y. It is made of heavy-gage tubular design and has a solid brass ball-jointed rod holder that is held in any predetermined position by a powerful stainless steel



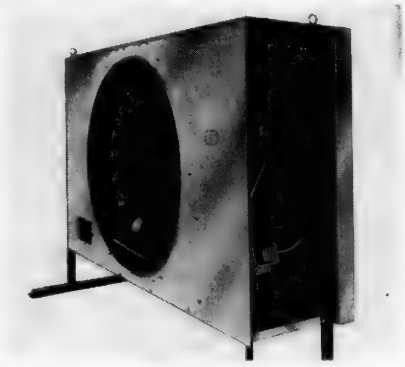
spring. The company states that hardware is absolutely self-aligning and non-binding. Positioning marks are clearly stamped, allowing for ease of installation onto blades.

For use on opposed action dampers, Oppo-Matic, consisting of the basic Ball-O-Matic bracket with the addition of a Micro-Set plate and a smaller companion bracket, was developed. All other stops are eliminated, and the need for bridges or stands is done away with. Over-riding and fluttering of blades is ended.

More information? Circle Item 16, postcard, last page.

Large Remote Condensing Unit

Dunham-Bush, Inc., West Hartford, Conn., introduces Model LRCU, a large remote condensing unit, available in five models with ratings from 10 to 30 tons.



It consists of the company's BC-P remote air-cooled condenser, with compressor, receiver, electrical controls, and other refrigeration accessories mounted within the casing of the condenser. Compressors can be single or dual; where dual compressors are used, completely separate refrigeration circuits are furnished. Units are shipped with a holding charge.

More information? Circle Item 17, postcard, last page.

Packaged Hot Water Boiler

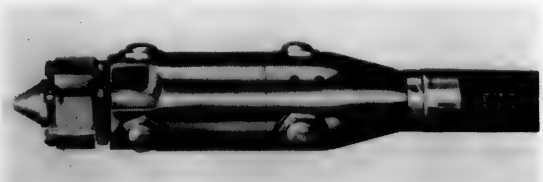
Orr & Sembower, Inc., Reading, Pa., is marketing a new hot water heating boiler in sizes from 500,000 to 20,000,000 Btu per hr. The Powermaster hot water boiler is designed especially for forced circulation hot water systems for commercial and industrial space heating.

The internal boiler water circulation arrangement permits the boiler to withstand three times its rated capacity in terms of thermal shock, the company reports. Both the rate of change of internal temperature and high temperature differentials across the boiler have been considered in the design of internal circulation arrangements.

More information? Circle Item 18, postcard, last page.

Air-Powered Tube Reamer

Viking Research Corp., Sheboygan, Wis., is marketing a new air-powered tube and boiler flue reamer for oil, coal, or gas-fired boilers. The reamer will clean boilers up to twice as fast as conventional methods, and requires



only one man to operate, according to the company.

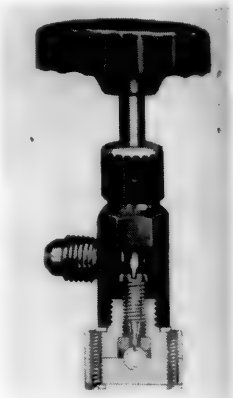
Tool is called the Viking Jet-Air tube reamer and is designed to be operated on a building's central compressed air supply, though auxiliary compressors may be used when a central supply system is not available. The tool operates on 60 to 90 psi of air pressure.

Exhaust air from the motor is driven forward through jets in the nose of the tool. Fly ash, soot, and scale are blown into the breeching and away from the operator. Special domes on the housing of the tool hold the reamer in the center of the boiler tube during operation and prevent damaging wobble and chatter.

More information? Circle Item 19, postcard, last page.

Tube-Piercing and Tapping Valves

A complete line of small and inexpensive tube-piercing and tapping valves, including line tap, line port, can tap, and control valves, is announced by Henry Valve Co., Melrose Park, Ill., for refrigeration, air conditioning and industrial applications. These valves are suitable for use with aluminum, copper or steel tubing.



The line tap and line port valves provide a permanent capped port for charging, discharging and testing. Line port valves are primarily for sealed systems. The control valves, both angle and two-way types, are designed for use with all these auxiliary valves and provided with a screw driver tip for ease of operation. Being essentially two valves employed together to pierce lines or cans, the control valve is removable, leaving the line tap or can tap valves in place for further use. A seal cap is then installed on permanent fitting.

Can tap valves screw directly onto refrigerant containers and pierce the can seal to release refrigerant. Use of the two-way control valve permits connection to a gauge and a charging line in series to one or any number of refrigerant containers simultaneously, thus eliminating the need for a charging manifold.

Illustrated is a Henry CV-1 angle control valve showing method of operation with a line tap valve.

More information? Circle Item 20, postcard, last page.

Neoprene Roof Vent Flashings

Carrollton Manufacturing Co., Carrollton, Ohio, has expanded its product lines with the addition of Carlton Mono-Flash roof vent flashings. Developed for use on residential and commercial buildings, flashing is a lightweight flexible, one-piece Neoprene unit featuring a double-seal collar design. It is easily positioned on vent pipes and requires only a non-hardening caulking compound to provide a permanent weather-tight seal. Complete installation can be made in minutes by one man.

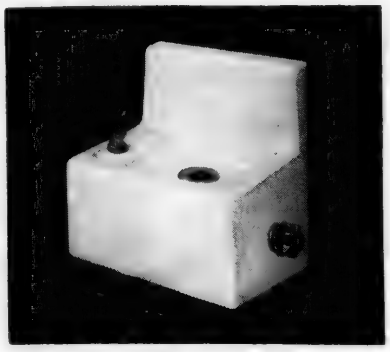
Flashings are available in a range of types and sizes to accommodate standard vent pipes and roof slopes.

More information? Circle Item 21, postcard, last page.

Wall Hung Drinking Fountains

Three new wall hung, acid-resisting, vitreous china drinking fountains have been added to the line of Richmond Plumbing Fixtures Div., Rheem Manufacturing Co., Metuchen, N. J.

Designed to harmonize with modern interiors in form



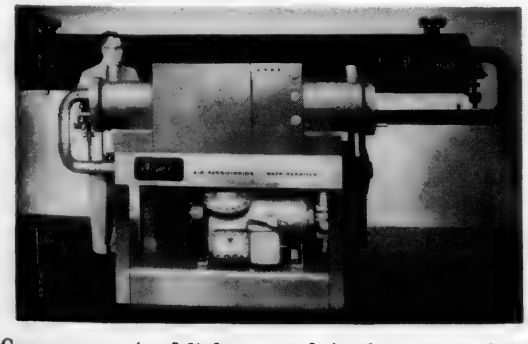
and function, they meet rigid architectural standards and requirements. All three measure 14 by 12½ inches. The Weldon has a ¾-inch back; the Welback, 6-inch back; and the Welfount, 12-inch back. They are available in white and seven colors.

Features include shielded anti-squirt angle stream bubbler; automatic pressure regulator with flow control; four-arm handle self-closing control valve; and stainless steel cover for access opening.

More information? Circle Item 22, postcard, last page.

Chillers in Smaller Package

Redesign of its packaged water chiller line, with savings in space up to 50%; production of new packaged air conditioners; and availability of complete air conditioning systems are announced by Acme Industries, Inc., Jackson, Mich. The company's prior emphasis has been in the manufacture of cooling components, especially water chillers, for sale to other major air conditioning firms which integrated them into systems.



Compactness (and lighter weight) of its water chillers, in ratings from 3-125 tons and in both hermetic and direct-drive designs, has been accomplished by a more economical arrangement of shell and tube bundle, and by more efficient insulation. Further, components have been matched in order to fit within a smaller area, as illustrated. A new 60-ton chiller is shown in front of the old 60-ton model. The old model is retained in the company's line, however, for special applications as chilling of brine and industrial coolants.

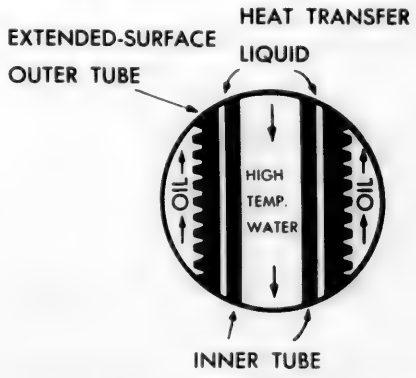
Introduction of packaged air conditioners in capacities from 3-60 tons with direct expansion cooling coils rounds out the company's line of air conditioning apparatus which also includes evaporative condensers, multizone air handlers, and fan-coil room units. Therefore, the company states, the components are now available for several complete systems for year-round air conditioning. For instance, a packaged water chiller may be teamed with an evaporative condenser to supply chilled water to room fan-coil units, a packaged air conditioner (with self-contained evaporative condenser and hot water or steam coils) can supply ducted conditioned air to an air distribution system, or a chiller and evaporative condenser can supply chilled water to a multi-zone air handler to supply warm and cool conditioned air through any air distribution system.

More information? Circle Item 23, postcard, last page.

HTW Fuel Oil Heater

New design features incorporated in the Paracoil Thermo-Film safety-barrier type fuel oil heater now make it suitable for direct use in oil-fired high temperature hot water systems, according to the manufacturer, Davis Engineering Corp., New York, N. Y.

The preheating of No. 6 fuel oil with HTW in most



systems necessitates the use of steam evaporators or isolating water-to-water exchangers to prevent oil from leaking into the HTW stream. Such designs require a minimum of two heat exchangers with connecting piping, regulators, level controls, etc.

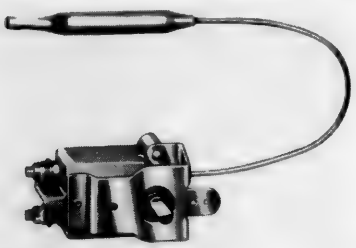
However, a single Thermo-Film heater provides adequate oil temperature, completely isolates the HTW circuit from the oil circuit, requires less space, is simple to operate, and costs substantially less to install, the company states.

A number of double tube elements are enclosed within the heater shell. Oil to be heated flows through the shell; water flows in the opposite direction through the inner tube. Separating the oil and water is a very thin film of heat transfer fluid in the space between the tubes. In the rare event of an oil tube failure, the free oil cannot contaminate the HTW stream as it becomes trapped in the heat transfer liquid system and rises in the expansion chamber sight glass to warn operating personnel.

More information? Circle Item 24, postcard, last page.

Electric Heat Thermostat

White-Rodgers Co., St. Louis, Mo., announces Series 261, single pole, remote bulb, electric heat thermostat. Designed primarily for electric baseboard, wall heaters, and portable heaters, its size and versatility, according



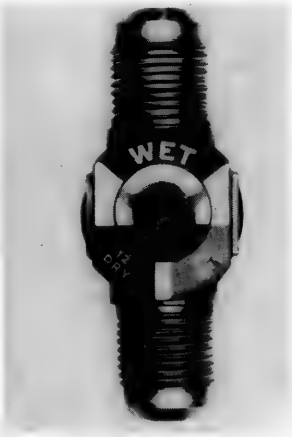
to the company, make the unit readily adaptable to applications on any non-inductive load not exceeding 5000 watts. Thermostat is only 2 29/32 by 1 11/16 by 1 57/64 inches, making it adaptable to narrow baseboard heaters and other close-quarter applications.

Control features utmost sensitivity, the company reports, with narrow differential of 1½ deg F. It has a range of 50 to 100 deg, with shaft adjustment in a 225° arc, and has "cold" position where contacts are held open. Both 6 and 12-inch capillary lengths are standard, with other lengths available. For areas requiring a thermostat having double pole disconnect, Series 262 controls are available.

More information? Circle Item 25, postcard, last page.

Product Life Extended

Super Dry-Eye, a combination sight glass and moisture indicator, used in conjunction with company's desiccant on refrigeration and air conditioning equipment, has been redesigned to extend the life of its indicating elements, according to an announcement by Refrigeration Products Div., Ansul Chemical Co., Marinette, Wis.,



Life of the indicating elements is extended by a pad and filter which protects them from the constant flow of refrigerant. Minute particles of circulating solids are collected by the filter, leaving the moisture indicating elements dirt-free. Full-view sight glass area has been retained by re-locating the moisture indicating elements across the bottom third of the sight glass. An improved Freon-22 indicating element, under development for more than a year, is incorporated. Made of woven, non-fibrous material, the indicator resists both the adherence of solids and staining by oil breakdown products.

Both elements, one for Freon-12 and the other for Freon-22, have rapid color changing properties, the company states. Vividness of the coloring has been heightened for easier visibility.

More information? Circle Item 26, postcard, last page.

Deodorant for Package Units

The Sentinel, an odor control system for use in conjunction with packaged air conditioning systems, is offered by Airkem, Inc., New York, N. Y. It is based on a new product, Solidaire, a solid form of the company's odor counteractant.

For dispensing the deodorant, a two-section unit is used. An inner unit made of anodized aluminum meas-

ures 15¾ by 9⅓ by 4½ inches. This is fastened to the air conditioner cabinet so that the vapors from the evaporation chamber of the deodorizer are drawn into cooling unit's air stream. A template is provided to guide the installer in cutting a small hole in the conditioner jacket. Design of the dispenser is such that there is a continuous, gradual supply of the solid deodorant into the evaporation chamber.

An outer cover, as illustrated, fits over the inner one for applications where a more finished appearance is required. Unit is completely self-contained, needing no electrical or mechanical power.

More information? Circle Item 27, postcard, last page.

Variable Speed Pulleys

Constant speed regardless of wide variations in load is a major feature of an economy line of variable speed pulleys. This is accomplished by means of a cam which automatically maintains required belt tension for a given load. Thus, the pulley faces are prevented from spreading and the pitch diameter held at the desired setting. Belts are never subjected to excessive pressure, since the contact springs serve only to maintain initial tension, according to the manufacturer, Lovejoy Flexible Coupling Co., Chicago, Ill.

Known as the Hi-Lo FHP line, these pulleys are extremely compact in both diameter and length. They are available in three horsepower ratings: ½, ¾ and 1 at 1750 rpm. The ½-hp unit is available with either high impact plastic or cast iron face; other sizes are cast iron.

More information? Circle Item 28, postcard, last page.

Stainless Steel Condenser Tubes

Stainless steel condenser tubes fabricated by welding from Types 316 and 304 stainless steel strip are available from Chase Brass & Copper Co., Waterbury, Conn. These tubes are produced to Specifications ASTM A-249 or ASTM A-269.

Stainless steel has higher temperatures and corrosion resistance, and resists steam impingement to a far greater degree than conventional condenser tube alloys, the company reports. Types 304 and 316 both have excellent life in highly acid waters and contaminated harbor waters. Type 316 is preferred with high chloride concentrations.

More information? Circle Item 29, postcard, last page.

Gas Unit Heaters

A compactly designed gas unit heater, introduced by Hastings Air Control, Inc., of Omaha, Neb., is said to solve the problem of installing unit heaters in rooms with low ceilings. The series, called Micro-Heaters because of their small size, is suited for use in offices, schools, garages, hallways, shops, or any other low-ceiling rooms.

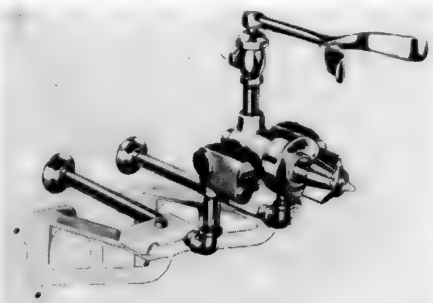
Only 22½ inches high, the units have input ratings of 25,000 to 75,000 Btu per hr. Other models complete the company's line to 250,000 Btu per hr. All are AGA-approved for natural, LP, mixed, and manufactured gases.

Four-way distribution louvers, provided as standard equipment, spread the warm air evenly around the heated space, and completely eliminate hot blasts directly in front of the heater, the company reports.

More information? Circle Item 30, postcard, last page.

Knee-Operated Mixing Valve

For industrial washing operations where the worker's hands are not free to control the water, a knee-operated version of the Hydroguard thermostatic mixing valve is available from The Powers Regulator Co., Skokie, Ill.



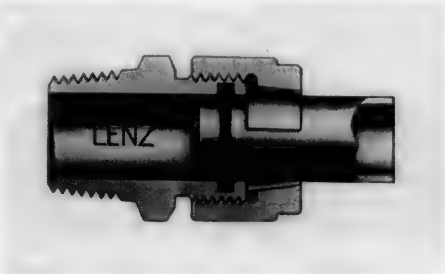
Once the mixer has been turned to provide the water temperature desired, the worker simply moves the volume lever with his knee to turn the water on and off. His hands are completely free to hold or manipulate his work.

The Type H Hydroguard has a 10 gpm capacity at 45-lb pressure. It is accurate to within plus or minus ½ deg F, and can provide water at any temperature between 65 and 110 deg.

More information? Circle Item 31, postcard, last page.

O-Ring Tube Fitting

The Lenz O-ring tube fitting is used on vacuum, air, and hydraulic systems. The fitting, manufactured by Lenz Company, Dayton, Ohio, seals by means of a standard stock O-ring. A split tapered sleeve holds the tubing in place when the clamping nut is drawn up. Excessive wrench torque is unnecessary because the seal



does not depend on the tightness of the nut. The nut fits loosely on tubing for ease of assembly. The higher the pressure, the greater the grip of the tubing, and the greater the seal of the O-ring.

No exact tube length is necessary. There is no metal to metal seal, therefore no concentration of stresses due to flares or ferrules for tube failures, making it a superior fitting under shock and vibration, according to the company.

Fittings are available in a full range of shapes, including connectors, unions, elbows, tees, crosses and bulkhead connections in tube sizes from ⅛ to 2-inch OD.

More information? Circle Item 32, postcard, last page.

Easily Cleaned Filter

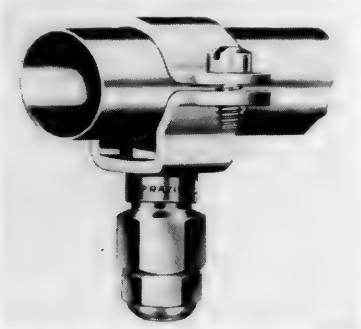
Pliotron CR, a permanent type, electrostatic air filter for heating, ventilating and air conditioning systems, for commercial or residential use, is being put on the market by Goodyear Tire & Rubber Co., Akron, Ohio. Chief advantage of the new filter is easy maintenance. Except in cases where unusually greasy dust or soot is encountered, the filter can be cleaned in seconds with an ordinary, suction-type household vacuum cleaner, the company states. Most filters of this type must be immersed in water to release charged particles of dust.

The new cleaning technique was tested with every type of household dust and contaminates common to commercial and industrial areas. It was found that the suction power of electric vacuum cleaners is adequate to overcome the pull of static charges on captured particles.

More information? Circle Item 33, postcard, last page.

Split-Eyelet Connectors

Designed for liquid, gas and air lines, and for pressures up to 250 psi, No. 7521 split-eyelet connectors are available from Spraying Systems Co., Bellwood, Ill. They are said to provide leak-proof connection and simplified mounting of ⅛ and ¼-inch spray nozzles of all types;



are supplied in clamp sizes to fit ½, ¾, and 1-inch pipe, and tubing in sizes ranging from 13/16 through 1⅜-inch OD. Connectors also facilitate mounting of equipment such as gages and hose.

In this split-eyelet design, the body unit is separate from the clamp member, and liquids or gases come only in contact with the body. As a result, the body can be offered in metals most compatible with the liquid or gas handled. The twin-bolt clamp member is made in heavy-duty steel or stainless steel for maximum leverage and thread strength under compression.

More information? Circle Item 34, postcard, last page.

Form for Laying Ducts

Save-Crete, a form for laying ducts for floor slab perimeter heating, is announced by Eward Associates, Seattle, Wash. It is said to ensure complete encasing of the duct to a predetermined thickness and to effect savings up to 50% in the amount of concrete used. Further, the manufacturer states, it prevents floating or shifting of the duct while concrete is being poured, keeps dirt out of the concrete, and permits accurate specification of the

quantity of concrete needed for a given job.

The only special materials required are the Spreader Spring, which is wrapped around the duct at intervals as a spacer, and the Ply which is wrapped around the springs. Concrete poured into the top of the form flows freely between the springs and around the duct, but cannot spread into the trench. In this way the need for digging extremely accurate trenches is eliminated.

The form can be used on 4-36 inch dia. ducts, allowing either a 2 or 3-inch thickness of concrete. Complete working instructions, with specifications for all materials in relation to the diameter of the duct, are supplied, the company says.

More information? Circle Item 35, postcard, last page.

Forged Steel Globe Valves

Several new design features are incorporated in a line of 600-psi forged steel globe valves introduced by Edward Valves, Inc., East Chicago, Ind., subsidiary of Rockwell Manufacturing Co. The valves are suitable for steam, oil, water, and gas lines.

They are available in ¼ through 1-inch sizes with ratings of 600 psi at 910 deg F in carbon steel, and 600 psi at 1030 deg in chrome-molybdenum steel. Screwed end and welding end models are standard. The new line is designated the Fig. 848 Series.

Four high-strength molybdenum alloy cap screws hold the bonnet to the body. Only 40 ft-lb tightening torque is required. A spiral-wound stainless steel and asbestos gasket seals the body-bonnet joint. The mating faces of this joint are machined to keep the gasket under controlled compression. Body and bonnet are all forged to give compact design and to conserve weight and bulk, while assuring soundness and strength.

Pressure drop and stem wear due to erosion are both reduced because the angle stem turns flow through only 180 degrees. This is the only bolted bonnet globe valve in its size range with an angled stem, the company reports.

More information? Circle Item 36, postcard, last page.

New Type Pipe Dope

A new kind of pipe dope, claimed to have qualities superior to any other method of pipe joint sealing, is announced by Permacel, New Brunswick, N. J.

The product, Permacel Ribbon Dope comes in roll form in 260 and 520-inch lengths, rather than in a liquid or semi-liquid form, thereby eliminating spillage, shrinkage, evaporation and need for brushes. A 260-inch roll will do up to 100 one-inch pipe joints, and the 520-inch size up to 200 one-inch pipe joints. Each roll is packaged in an individual dispenser box, and has an unlimited shelf life.

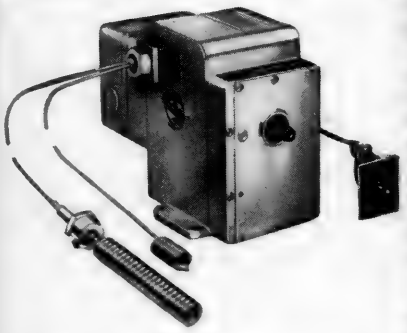
More information? Circle Item 37, postcard, last page.

(Continued on page 112)

THE MARK OF QUALITY

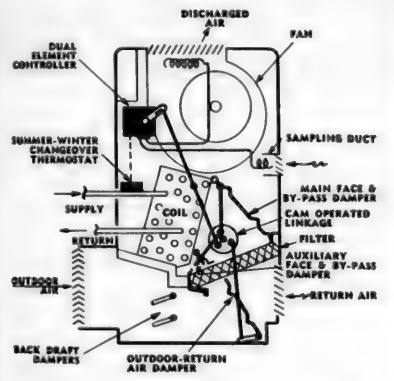
BARBER COLMAN

Now...improved controls for all types of unit ventilators

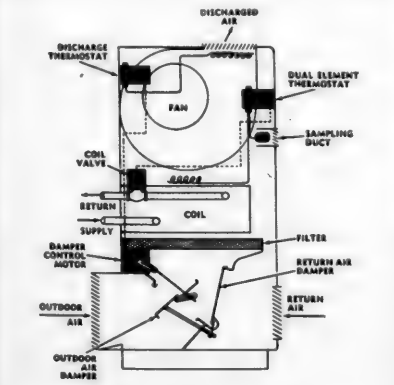


NEW! Dual-element thermostat *combined* with motor operator for face and bypass units.

NEW! Plug-in change-over thermostat for year-around face and bypass units.



FACE AND BYPASS CHAMBER CONTROLLED UNIT



VALVE CONTROLLED UNIT

Combined thermostat-and-motor operator mounts directly on unit for greater control accuracy and lower installation cost.

New all-electric Barber-Colman unit ventilator controls combine the function of thermostat and damper operator in a single "package." This eliminates the need for a wall thermostat and reduces on-the-job installation cost. (Factory installation is also practical.) Chalk dust or dirt problems and "temperature-tampering" by unauthorized personnel are eliminated.

Superior control is achieved by the dual-element principle. Sensing bulbs are used in both a room air sampling chamber and in the discharge air stream. This is the proved aspirating principle employed in the most exacting laboratory control installations.

Barber-Colman offers you the most advanced controls for *every* unit ventilator installation — steam, hot water, hot and chilled water, gas, and electric.

Ask for New Application File

— specifications and complete details on control hookups for all leading makes and models of unit ventilators. Call your local Barber-Colman representative or write today.

BARBER-COLMAN COMPANY

Dept. K, 1302 Rock Street, Rockford, Illinois • Field Offices in Principle Cities

Automatic Controls • Small Motors • Industrial Instruments • Aircraft Controls
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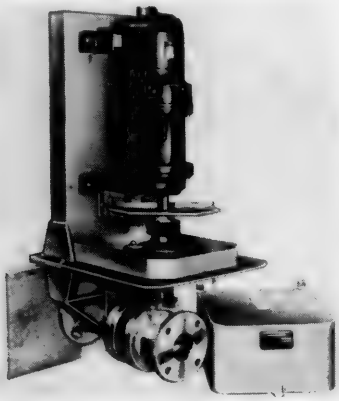
Molded Products • Metal Cutting Tools • Machine Tools • Textile Machinery

(Continued from page 110)

Motor Valve Fails Safe

A heavy-duty liquid valve designed for remote control operation by Gemco Incorporated, Cleveland, Ohio, incorporates a fail-safe mechanism that immediately closes the valve should a power failure occur.



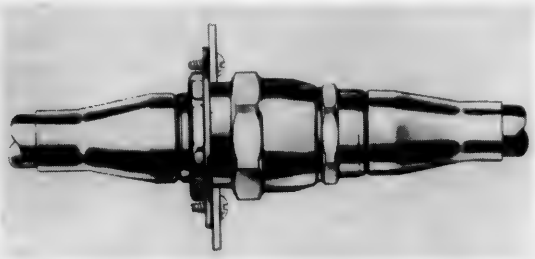
The valve's torque-type motor operates to a stall in both open and closed positions, so that no limit switches are required. Floating bronze valve ball is hard chrome plated to resist scratching, pitting, and abrasion. Resilient synthetic rubber seat is wiped clean each time valve is opened or closed. According to the manufacturer, these features guarantee practically maintenance-free operation.

Water friction and turbulence is minimized because full round port area does not change the water stream shape. Two standard sizes, one for 3-inch and one for 4-inch pipe are offered. Other sizes are offered custom built. All are available in stainless steel for highly corrosive applications. The company also manufactures a full line of control systems for use with the valves.

More information? Circle Item 38, postcard, last page.

Permits Unit Precharging

An improved self-sealing coupling, Series 5500, is developed by Aeroquip Corp., Jackson, Mich., for air conditioning and refrigeration applications. Coupling is primarily for use on commercial and residential units, where evaporator and condenser sections are built separately.



It is suitable for use with numerous refrigerants, including F-12 and 22 and similar compounds.

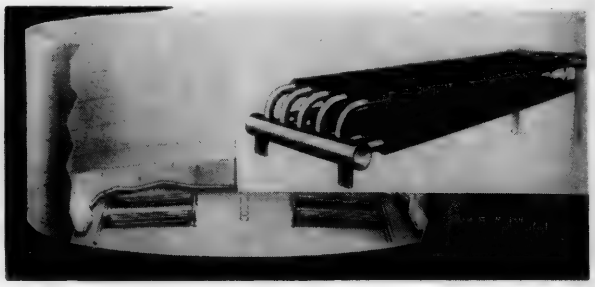
Coupling permits factory testing and precharging of air conditioners, which may then be shipped and stored fully charged with refrigerant. Hence, field installation time and costs are substantially reduced. Coupling is leakproof. When disconnected, coupling halves seal tight to prevent loss of refrigerant and admission of air or foreign particles into the refrigerant system.

More information? Circle Item 39, postcard, last page.

Platform Type Tank Heaters

Brown Fintube Co., Elyria, Ohio, has expanded its line of Thermo-Flo tank heaters by incorporating a horizontal or platform design for installation in floating-roof tanks.

Designated Model FR-11, these heaters have a flat design so that they can operate in the clearance allowable when floating roofs are in the lowest position. Maximum height installed is 15 inches from the tank bottom. The heaters are mounted on short, rigid legs, to allow a minimum clearance of the tank bottom of 2 inches. This



clearance, plus convection effects, keeps the heater from becoming buried in sediment on the tank bottom and facilitates tank cleaning. The heaters, although horizontal, are slightly pitched to insure run-off of condensate.

The units are so compact that they can be installed through a 10-inch dia manhole. Since the coils become a part of the piping, field welded connections per tank are reduced to a minimum. Manufactured in standard modular units, the tank heaters can be readily connected in series to meet any tank capacity, or can be moved from tank to tank without danger of obsolescence.

More information? Circle Item 40, postcard, last page.

Remote-Type Conditioners

Refrigeration Appliances, Inc., Chicago, Ill., announces development of two larger sizes in its Krack Komfort Master series of remote-type air conditioners. The two new units have capacities of 7½ and 10 tons.

The additions to the series make a total of five sizes available, ranging from 2 to 10 tons. Units are made in three versions; double blower in the larger models, single blower in the smaller models, and stripped or cabinetless units for use on furred-in installations.

Units are basically designed for ceiling suspension but have been engineered to permit convenient floor installation wherever preferable. They are also adaptable for use with ducts.

More information? Circle Item 41, postcard, last page.

(Continued on page 114)

CASE #101—Another case where General Electric Factory-Assembled Air Conditioning Units proved more economical than field-assembled systems.

Galt Ocean Mile Hotel—Fort Lauderdale's newest and largest, built by the Atlantic Const. & Eng. Co., Ft. Lauderdale—provides the finest, most luxurious and congenial accommodations—including General Electric Zone-by-Zone Air Conditioning.

GENERAL ELECTRIC **ZONE-BY-ZONE AIR CONDITIONING** SAVES FORT LAUDERDALE'S NEWEST, LARGEST HOTEL $50,000 INITIALLY—SPACE WORTH $3,000 ANNUALLY IN RENTALS

When the beautiful new Galt Ocean Mile Hotel, Fort Lauderdale, Fla., chose General Electric Zone-by-Zone Air Conditioning over a field-assembled central station system—it scored three ways in economy.

(1) Owing to simplified installation, an initial saving of $50,000 was accomplished. (2) Space saved is worth $3,000 a year in rentable room space. (3) Further savings are achieved through General Electric's individual zone control—enables management to cool only the areas it wants when it wants—servicing of one unit in no way interferes with the performance of the others. Meanwhile, the comfort, cleanliness and quiet operation of this General Electric system is one of the major guest-pleasing attributes of the hotel. This is another typical example of how General Electric Factory-Assembled units meet the most exacting air conditioning requirements economically and efficiently.

General Electric's complete line is flexible enough to meet every air conditioning need for all buildings—large or small—old or new. Ceiling-mounted units water-cooled up to 7½ tons—air-cooled up to 10 tons. Floor-mounted units—water-cooled up to 30 tons—air-cooled up to 20 tons. Steam and hot water coils available for all models. Discover how General Electric Factory-Assembled Units can simplify your planning. For full details write: General Electric Company, Air Conditioning Department, Troup Highway, Tyler, Texas.

Progress Is Our Most Important Product

GENERAL ELECTRIC

In Canada, Canadian General Electric Co., Ltd., Montreal

(Continued from page 112)

Central Station Units

Central station air conditioning units in sizes to accommodate all types of buildings are offered by Young Radiator Co., Racine, Wis. Ten sizes range in air volume capacity from 700 to 28,000 cfm in the vertical and

horizontal types. Nine sizes in a selection of two to 21 zones are available in multizone units.

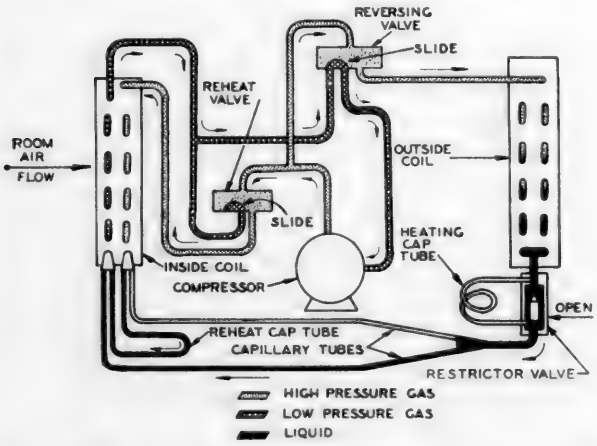
Bolting holes between all sections are common, making all sections interchangeable, making for easier installation through doorways and narrow passages. A catalog is offered which shows how to select the proper combination to solve a given problem.

More information? Circle Item 42, postcard, last page.

Humidity Control System

An automatic humidity control system which will eliminate one of the major complaints against air conditioning has been developed by Ranco Inc., Columbus, Ohio.

In effect, the system enables an air conditioner to provide dehumidification without producing uncomfortably low temperatures. When room temperature is above the desired temperature, the unit operates to do a cooling



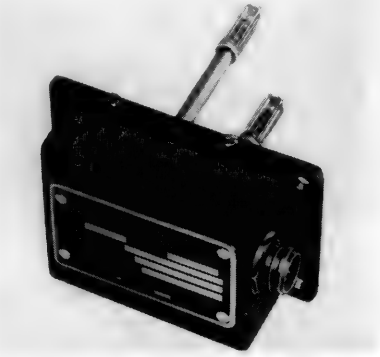
job. When room temperature starts to drop below the desired temperature, the unit operates to reduce humidity without further reduction of temperature.

The company states that the system operation is based on an adaptation of a thermostatic control and an automatic reversing valve the company developed for automatic heat pump systems. When the room thermostat drops slightly below the "cut-in" point, a contact is opened. This de-energizes the solenoid on the reheat valve, causing it to shift to the position shown in the diagram. This action sets up a refrigerant circuit whereby a portion of the hot discharge gas from the compressor goes to the outside coil, and the other portion goes to the reheat section of the inside coil. The return air section of the inside coil is connected directly with the suction side of the compressor, during this sequence of operations, making this section of the coil cold.

More information? Circle Item 43, postcard, last page.

Measures Air Mass Flow

A mass flow transducer with a range from 20 to 180 lb of air per min in a 6-inch duct and having no moving parts is in production at Trans-Sonics, Inc., Burlington, Mass. The advantage of this instrument is said to be its ability to measure mass, which is a quantity not influenced by the pressure or temperature of the gas. Transducer



provides a 100 microamp signal as a function of mass flow with a high degree of accuracy over an operating range of 40 to 150 deg F.

The transducer has been qualified for service in passenger-carrying commercial jet aircraft and is used to measure gas flow to a catalyst bed in a chemical plant. Other applications include service in heating, ventilating, and air conditioning equipment.

Transducer consists of a Zenner diode voltage regulator, bridge with temperature compensation, and two platinum sensing elements which extend into the flow stream. A D'Arsonval meter type of indicator, available for visual readout, is calibrated to correctly read the nonlinear output of the transducer.

More information? Circle Item 44, postcard, last page.

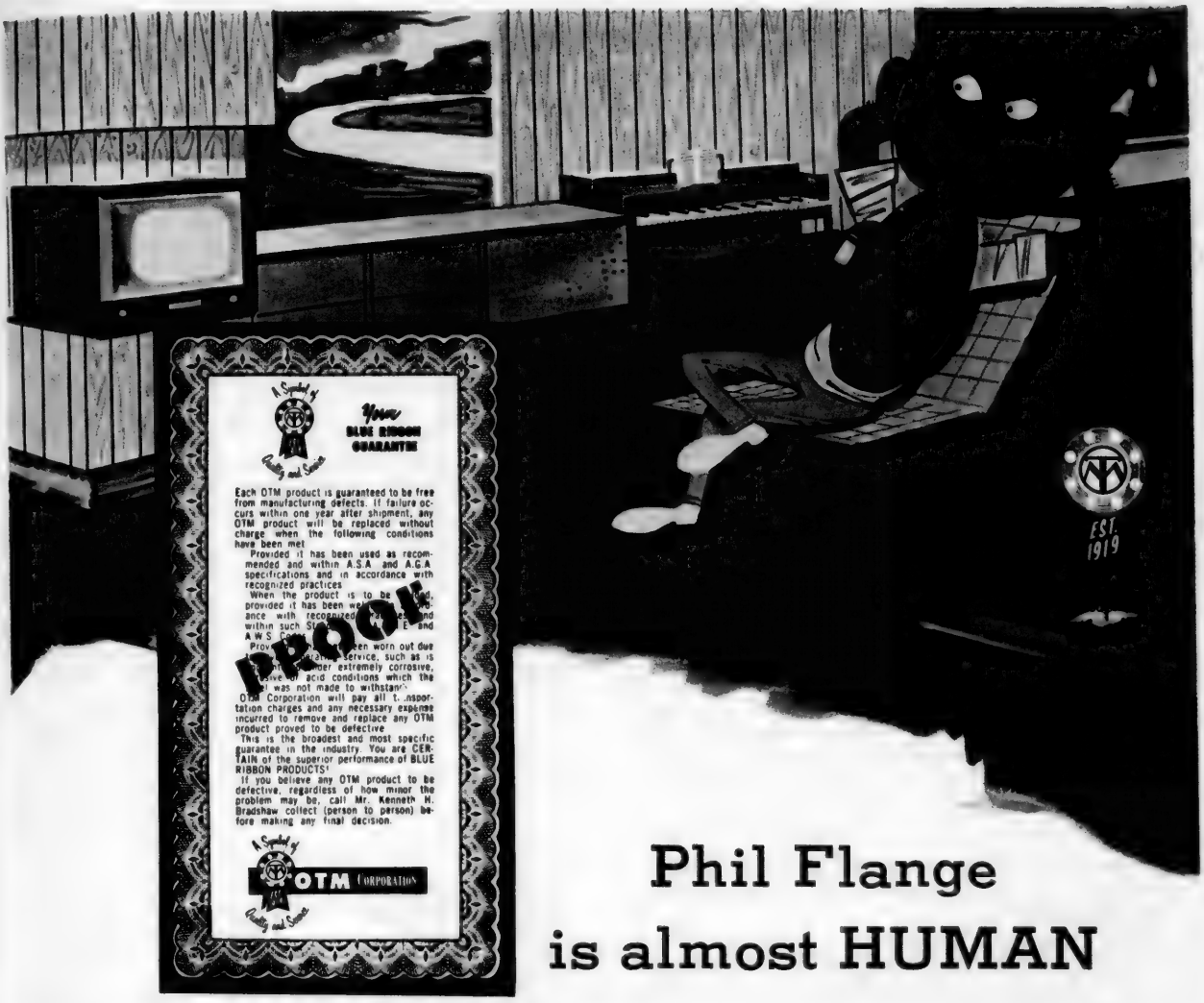
Line of Water Heaters

H. C. Little Burner Co., San Rafael, Calif., is manufacturing a complete line of gas-fired and electric water heaters.

The line includes both galvanized and glass-lined tanks of 20 to 100-gal capacities in residential and commercial models.

More information? Circle Item 45, postcard, last page.

(Continued on page 116)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BLUE RIBBON
GUARANTEE
Each OTM product is guaranteed to be free from manufacturing defects. If failure occurs within one year after shipment, any OTM product will be replaced without charge when the following conditions have been met:
Provided it has been used as recommended and within A.S.A. and A.G.A. specifications and in accordance with recognized practices.
When the product is to be
provided it has been
ance with recognized
within such
A.W.S.
Prov
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acid conditions which the
was not made to withstand.
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product proved to be defective.
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If you believe any OTM product to be defective, regardless of how minor the problem may be, call Mr. Kenneth H. Bradshaw collect (person to person) before making any final decision.
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OTM CORPORATION
ESI. 1919

Phil Flange is almost HUMAN

and we emphasize ALMOST because humans are not perfect but Phil is

He is one of the Blue Ribbon products made by OTM Corporation (he got a trophy for it, too!) . . . so Phil had to be a perfect forging in the first place. Then he was finished so fine that you could grade a micrometer on him. After that, he was checked and rechecked again and again . . . to make sure that when you get him he will be perfect. Phil is pretty proud of that Blue Ribbon Trophy too . . . because only the finest flanges and fittings can win the OTM Blue Ribbon Guarantee — a symbol of quality and service.

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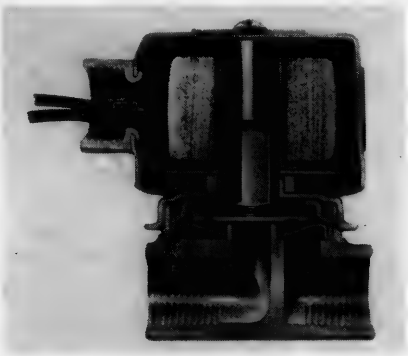
(Continued from page 114)

Solenoid Valve Additions

With the addition of two valves of 5/16 and ¾-inch port diameters, Jackes-Evans Manufacturing Co., St. Louis, Mo., has rounded out its line of Series J solenoid valves for industrial uses, providing a complete range from 5/16 to 1½-inch port diameters. Valves provide low-cost flow control of water, air, low pressure steam, light



oils, brines, industrial and LP gases.

Valves feature pilot operation, have only two moving parts, and can be mounted in any position. Line is being used successfully in such applications as water control on commercial garbage disposals and dish-washers, automatic lawn sprinklers, spray ponds, water softeners, air compressors, hot water heating systems, and many other industrial air and water uses.

More information? Circle Item 46, postcard, last page.

Automobile Heat Pump

Chatleff Valve & Mfg. Co., of Austin, Tex., offers a tested and proven reverse cycle kit for automobile application. Adaptable to all auto conditioners, these partly-preassembled components enable owners to enjoy year-around comfort from a single system.

Providing heating before car can leave drive-way, the unit equipped with the company's components offers comfort on short drives—eliminating slow warm-ups of conventional water systems. For the temperate and southern areas, heat available in the air is more than adequate for car comfort. For extreme conditions, northern climates and mountains, an auxiliary heat pick-up is available, using heat energy from the car engine to boost Freon evaporation.

The components add approximately 10% to the cooling system cost, but on new installations and for car makers, the kit eliminates the materials and labor now going into the conventional water heating systems, resulting in an overall savings. A new car purchaser may buy his car less heater and apply this saving to his Summer/Winter reverse-cycle system.

More information? Circle Item 47, postcard, last page.

Another
CAINS
COIL OF PROFIT
LOUVERAIL
ELIMINATES
Layout—Tab Cutting, Hole Punching, Riveting, Spot Welding, Etc..
Split (½) Rail for Louver thicknesses from 1¼ to 1¾". Use Full Size Rail for Louver thickness from 3¼" to 4".
Try this economical and practical method for fabricating Louvers — removable, hinged, or stationary. Louverail is 24 ga. galv. 4½" wide in (2—50' lengths) 1 right and 1 left coiled together. Hundreds of variations possible.
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A group of small girls at 36-in. Bradley Circular Washfountain.

Semi-Circular 54-in. models are well liked, too.

Bradley Column Showers have been installed in schools of all kinds and sizes from elementary schools to universities.

Do You Do School Work?

Large and small schools and colleges have become big users of Bradley Washfountains and Multi-Person Showers. School authorities, architects and builders have shown a growing preference for them. They provide the most sanitary, convenient, and economical facilities available. Bradley Washfountains and Showers offer you the opportunity of getting more school business—for new buildings and for modernizing present buildings.

If you haven't the latest data and specifications at hand, let us mail a copy of Catalog 5601 . . . Write today . . . BRADLEY WASHFOUNTAIN CO., 2352 W. Michigan St., Milwaukee 1, Wisconsin.

BRADLEY washfountains and showers

Air-Water-Cooled Condenser

Development of a combination air-cooled and water-cooled condenser, called the BCW unit, is announced by Dunham-Bush, Inc., West Hartford, Conn.

Unit operates as a normal air-cooled condenser up to a selected ambient temperature; its capacity is then supplemented by the use of water above that temperature. Also, the water side condensing surface is designed to handle the complete condensing load in the event of failure of the air-cooled system. Construction of the BCW units is the same as that of the company's BC remote air-cooled condensers, with the exception of the condenser coil.

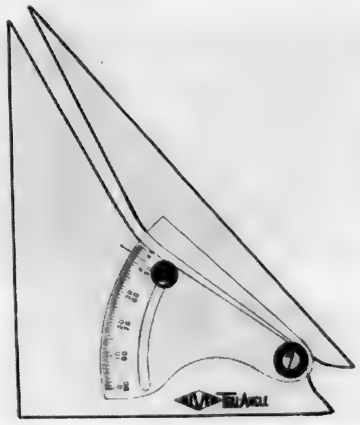
According to the manufacturer, design of the unit makes it possible to retain the advantages of an air-cooled condenser, and to utilize smaller size condensers. Less space is required. Design operating head pressures are maintained under all ambient conditions, and a secondary system which is capable of handling the complete condensing load in the event of condenser fan motor or belt failure, is provided.

More information? Circle Item 48, postcard, last page.

Fluorescent Protractor

A professional fluorescent protractor triangle offered by Alvin & Co., Inc., Windsor, Conn., is fabricated from clear, optical grade Plexiglass, said to eliminate all distortions. They reflect an orange tint and produce an orange light from all edges.

According to the manufacturer, the beveled edges eliminate any possibility of parallax lines; material is highly ductile, rigid, and shatterproof though only one-tenth inch thick; and the triangles will not darken, discolor, decompose, or warp.



The functions of protractor and triangle are combined. Angles from 0° to 90° are drawn from the base line. The adjustment arm is held firmly when adjusting to any angle by a knurled knob screw with metal insert. Available in various sizes.

More information? Circle Item 49, postcard, last page.

Your ideas work better when you work with HONEYWELL

The following pages bring you the latest developments in automatic controls from Honeywell. They widen your choice of products, give you more to work with.

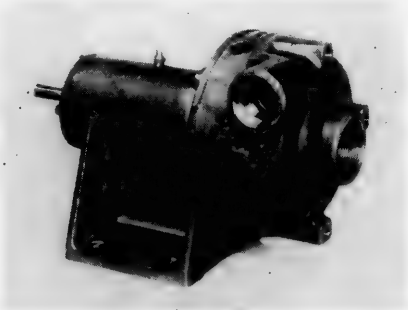
For complete information on these new control products and systems, call your nearest Honeywell sales office. Honeywell provides 112 offices throughout the country; each is staffed with capable control specialists to assist you in preparing proposals and writing specifications.

Look over these new products and systems. And, remember, they are backed by the kind of support only Honeywell can offer you.

FOR MORE TO WORK WITH ... WORK WITH HONEYWELL

Pedestal-Type Pumps

The addition of pedestal-type units to the company's present line of corrosion-resistant Bart Flex Seal centrifugal pumps is announced by Bart Manufacturing Corp., Belleville, N. J.



Capacity range at 3450 rpm, according to the company, is from 10 to 80 gpm against heads to 70 ft.

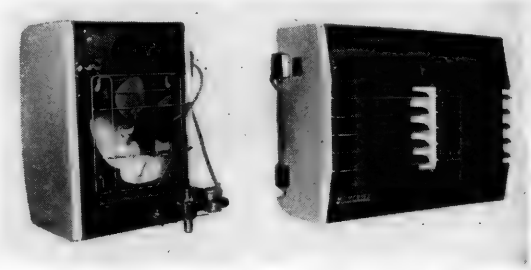
The company pointed out that solids from 3/16 up to 5/16-inch dia can be passed through the pumping chamber. Ports are 1 x ¾, and 1 x ½ x 1¼ inches.

Company's Flex Seal is self adjusting for wear and requires no run-in period. Pumps, either close-coupled or pedestal units, are recommended for temperatures to 300 deg F and viscosities to 300 SSU.

More information? Circle Item 50, postcard, last page.

Direct-Fired Gas Unit Heaters

The Henry Furnace Co., Medina, Ohio, announces five new models of direct-fired gas unit heaters. The Moncrief unit heaters are AGA-approved for installation in industrial, commercial and farm buildings, to burn either natural, manufactured, mixed or LP gas.



Unit heaters are equipped with a steel burner head which is tapered to deliver the fuel mixture to the entire length of stainless steel ribbon burners at the same pressure. As a result of this design, the burners are said to ignite more rapidly and burn cleaner.

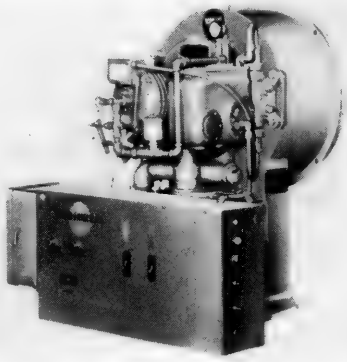
At left in photo is rear view of single heat exchanger models, available in 60,000, 90,000, and 120,000 Btu per hr capacities. At right is front view of double heat exchanger models, with capacities of 180,000 and 240,000 Btu per hr.

More information? Circle Item 51, postcard, last page.

In a restaurant application, the Honeywell Activated Charcoal Filter has high absorption capacity for such objectionable odors as tobacco smoke, burning fat, fish and others likely to be present. In the past, increased outdoor air intake was necessary to diffuse these odors, which resulted in higher air conditioning costs. Now Honeywell's filter removes the odors, enables air conditioning to be operated economically with reduced air intake.

Packaged Forced Draft Burners

Ray Burner Co., San Francisco, Calif., announces a new line of small capacity, rotary-type, packaged forced draft burners for application to multiple-pass scotch marine, water tube, and firebox boilers, and for other types of heat receivers designed for pressurized operation.

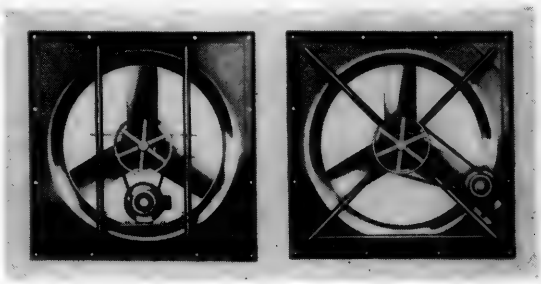


All are factory assembled, wired and tested, ready for utility hook-up. These fully automatic units, in appropriate sizes, develop capacities from 40 to 90 equivalent boiler horsepower. They feature electronic control, light or heavy oil operation, combination gas-oil operation, and instant fuel changeover on combination models.

More information? Circle Item 52, postcard, last page.

Line of Propeller Fans

A new line of Ventura propeller fans for industrial and commercial ventilation is available from American-Standard, American Blower Division, Detroit, Mich. Designated Model IC, the design features an improved, high-efficiency wheel configuration and an expanded capacity range.



Fans are available in 42 different low pressure models having certified ratings up to 75,330 cfm at zero static pressure, or 71,740 cfm at ⅛-inch w.g. static pressure. High pressure fans are available in 50 different models with certified ratings up to 81,100 cfm at zero pressure, or 44,800 cfm at 1-inch w.g. static pressure.

At left in photo is arrangement for fan sizes up to 42-inch nominal wheel diameter; at right is arrangement for fan sizes up to 72-inch nominal wheel diameter.

More information? Circle Item 53, postcard, last page.

For your mechanical systems... Honeywell Air Filters

Their activated charcoal removes odors, lowers air conditioning cost!

Only the best activated charcoal is used in Honeywell Air Filters. This charcoal, made from coconut shells, has more pores, more area for absorption. (Roughly, 125 acres per pound.) It is hard and durable, does not dust off or powder in service.

Here's a better, more economical solution to the problem of odors than either masking or diffusion. This new Honeywell Air Filter uses the principle of absorption by activated charcoal to filter return air, reduce the amount of intake air needed and produce savings in air conditioning installation and operating costs.

Combined with the Honeywell Electronic Air Cleaner, this new Air Filter provides air with the highest level of purity and cleanliness possible. Restaurants, hospitals and factories are only a few of the applications where this result is desired.

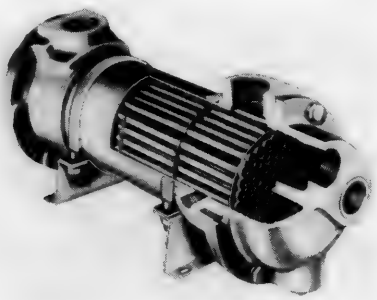
For convenience in specifying and installing, the Honeywell Air Filter is available in four different sizes and types of cells. These cells are easily removable from the frame for re-activation which Honeywell does at low cost. For further information, contact your local Honeywell office or write Minneapolis-Honeywell, Dept. HV-11-49, Minneapolis 8, Minnesota.

Honeywell

First in Control

Shell and Tube Heat Exchanger

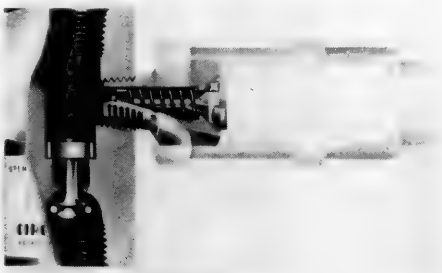
Perfex Corp., of Milwaukee, Wis., has developed and is now manufacturing a complete line of standard stock heat exchangers, known as Perfexchangers. This is an improved type of shell and tube heat exchanger in sizes from 1.3 to 200 sq ft of surface.



Design prevents bypass around the tube bundle, increasing efficiency 10 to 15%. Optimum clearance between tubes, shell, and baffles, together with more efficient tube spacing, further increases efficiency over units now available, the company reports. An added feature is the universal mounting bracket, which is detachable and rotates 360 degrees. Units are available in single, two, and four-pass models in a complete range of sizes. **More information? Circle Item 54, postcard, last page.**

Gage Protection System

A gage protection system, with instant and precise shutoff to protect gages from over-pressure, is offered by Circle Seal Products Co., Pasadena, Calif. The system provides in a single unit all characteristics necessary for protection of gages and operating personnel.

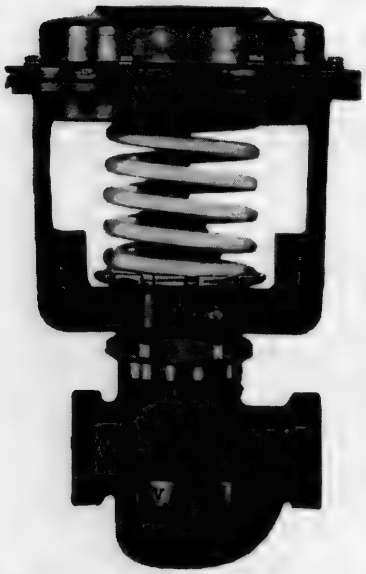


Designed for gas systems and available for liquid systems, the 1100 Series gage protector valves overcome the O-ring breakaway friction problem characteristic of piston type units, the company states. Precise operation is insured, even at very low settings, due to the use of contact rather than sliding seals.

Automatic gage cut-out and cut-in is provided. Snubbing action, in gas systems where surge or shock waves are encountered, reduces shock on gage elements. **More information? Circle Item 55, postcard, last page.**

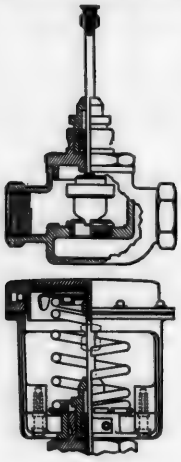
For your mechanical systems . . .
New Honeywell Pneumatic Valve and Motor

FOR MORE TO WORK WITH ... WORK WITH HONEYWELL



Single seated or three-way valves available in a complete range of sizes. For more information, call your local Honeywell office.

New materials... new designs increase performance for control of steam or water



Valve features! Equal percentage throttling plug plus longer stroke gives better control of steam or water flow at light load.

Exclusive Teflon cone packing lowers friction, lasts longer, requires less lubrication. Easier to change because it comes out with packing nut.

Spring loaded stem and disc holder connection eliminates noise and wear, lasts longer.

Plug type throttling guide eliminates "pocking" of discs due to impingement of fluid through old V Port types.

Packing nut design eliminates periodic tightening, impossible to over- or under-tighten.

Actuator features! Diaphragm design gives more power for smaller diameter. Saves space, positions valve better, gives high close-off ratings. Larger diameter spring eliminates buckling, doesn't rub stem.

Tough Neoprene diaphragm gives longer wear, in normal temperature use. (Silicon available for extremely high temperatures.)

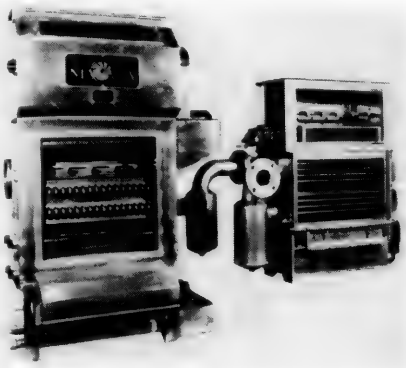
Quick stem-release slide makes actuator easy to remove from valve to change size or to service.

Normally open and normally closed actuators easily interchangeable. Sizes interchangeable, too.

All parts—corrosion resistant.

Cool, Clean, Compressed Air

Niagara Blower Co., New York, N. Y., announces a new method of providing compressed air, dried, cooled and cleaned for use with compressed air instruments or controls, and for industrial or chemical processes where the presence of moisture, dirt, or lubricating oil is undesirable or damaging. The method uses two air machines in series, the Niagara Aero after cooler and compressed air chiller.



In the first stage, the after cooler receives the hot air from the compressor and reduces its temperature to approximately that of the atmosphere. This is done by evaporative cooling, transferring the heat of compression to a stream of moving air by evaporating a water spray from the surface of the compressed air coils, in the air stream. At this point an oil separator removes the moisture and oil or dirt that has been condensed from the compressed air. In the second stage, the air chiller uses refrigeration to cool and further dry the air to meet very exacting specifications. Typical installation handles 900 cfm with 5-ton unit, producing 45-deg, 90 psig air.

More information? Circle Item 56, postcard, last page.

New Casing Closure Methods

E. B. Kaiser Co., Glenview, Ill., manufacturer of Ebko prefabricated insulated piping systems, announces five new methods of closing the steel and cast iron casings.

Now, in addition to Welding End and Flanged steel casings, contractors or engineers can order Quick Coupler, Coupling, or Telescoping End.

In addition to Flanged End cast iron casings, there are now available Solid Sleeve and Mechanical Joint closing methods.

By giving engineers and contractors a larger choice of closing methods, job conditions are more flexibly met. As an example, should the availability of welders be at a minimum and an early construction date have to be met, Quick Coupler casing might be specified.

More information? Circle Item 57, postcard, last page.

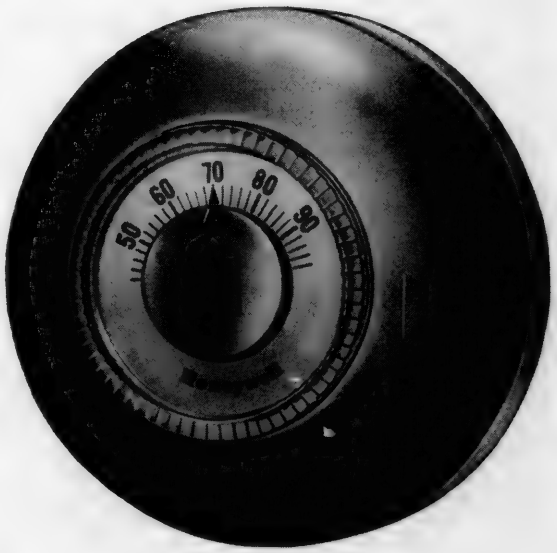
For your mechanical systems

Now, a Honeywell Pneumatic Round Thermostat for every installation, every function!

Now Honeywell offers models of the famous Pneumatic Round Thermostat for every application—summer-winter, day-night, modulating, two-position, and submaster.

All versions provide the accuracy, fast-response and dependability of the Honeywell Pneumatic Round, the only new pneumatic thermostat in the industry. And all models feature the world's most popular round thermostat styling.

Simplified design and a complete line of installation fittings make these thermostats easy to install and maintain. Pleasingly styled, tamper-proof guards are available where needed.



Honeywell

First in Control

DEGREE-DAYS FOR SEPTEMBER, 1958

(A) Airport readings; (C) City office readings; (O) Readings at a point on outskirts of city

AIR CONDITIONING, HEATING AND VENTILATING'S 31st Year of Publication of Monthly Degree-Day Data

City	September			Season to Sept. 30, incl., from Sept. 1		
	1958	1957	Normal	1958	1957	Normal
Abilene, Texas (A)	6	6	5	6	6	5
Albany, New York (A)	142	152	139	142	152	139
Albuquerque, New Mexico (A)	35	3	10	35	3	10
Alpena, Michigan (C)	201	245	215	201	245	215
Asheville, North Carolina (C)	41	60	50	41	60	50
Atlanta, Georgia (A)	0	36	8	0	36	8
Atlantic City, New Jersey (A)	62	40	29	62	40	29
Augusta, Georgia (A)	1	19	0	1	19	0
Baltimore, Maryland (C)	21	33	29	21	33	29
Billings, Montana (A)	162	188	194	162	188	194
Binghamton, New York (C)	155	131	141	155	131	141
Birmingham, Alabama (A)	0	24	13	0	24	13
Bismarck, North Dakota (A)	185	264	227	185	264	227
Block Island, Rhode Island (A)	86	67	88	86	67	88
Boise, Idaho (A)	143	65	135	143	65	135
Boston, Massachusetts (A)	(a)	57	77	(a)	57	77
Buffalo, New York (A)	125	140	122	125	140	122
Burlington, Iowa (A)	82	97	83	82	97	83
Burlington, Vermont (A)	191	169	172	191	169	172
Cairo, Illinois (C)	18	7	28	18	7	28
Charleston, South Carolina (C)	0	2	0	0	2	0
Charlotte, North Carolina (A)	2	37	7	2	37	7
Chattanooga, Tennessee (A)	8	19	24	8	19	24
Cheyenne, Wyoming (A)	203	284	241	203	284	241
Chicago, Illinois (A)	67	89	90	67	89	90
Cincinnati, Ohio (C)	22	30	42	22	30	42
Cleveland, Ohio (A)	86	97	75	86	97	75
Columbia, Missouri (A)	48	47	62	48	47	62
Columbia, South Carolina (A)	3	20	0	3	20	0
Columbus, Ohio (C)	54	59	59	54	59	59
Concord, New Hampshire (A)	182	167	192	182	167	192
Concordia, Kansas (C)	50	54	55	50	54	55
Dallas, Texas (A)	0	0	0	0	0	0
Dayton, Ohio (A)	69	77	74	69	77	74
Denver, Colorado (A)	106	141	120	106	141	120
Des Moines, Iowa (A)	77	113	99	77	113	99
Detroit, Michigan (A)	98	130	96	98	130	96
Devils Lake, North Dakota (C)	258	340	276	258	340	276
Dodge City, Kansas (A)	48	55	40	48	55	40
Dubuque, Iowa (A)	130	180	149	130	180	149
Duluth, Minnesota (C)	279	357	277	279	357	277
Elkins, West Virginia (A)	145	109	122	145	109	122
El Paso, Texas (A)	16	0	0	16	0	0
Ely, Nevada (A)	227	252	228	227	252	228
Escanaba, Michigan (C)	230	292	247	230	292	247
Evansville, Indiana (A)	39	28	59	39	28	59
Fargo, North Dakota (A)	174	274	215	174	274	215
Fort Smith, Arkansas (A)	14	3	9	14	3	9
Fort Wayne, Indiana (A)	106	140	107	106	140	107
Fort Worth, Texas (A)	0	0	0	0	0	0
Fresno, California (A)	2	0	0	2	0	0
Galveston, Texas (C)	0	0	0	0	0	0
Grand Junction, Colorado (A)	62	55	36	62	55	36
Grand Rapids, Michigan (A)	151	196	144	151	196	144
Green Bay, Wisconsin (A)	194	263	183	194	263	183
Greensboro, North Carolina (A)	21	52	29	21	52	29
Greenville, South Carolina (A)	(a)	43	10	(a)	43	10
Harrisburg, Pennsylvania (A)	62	76	69	62	76	69
Hartford, Connecticut (A)	136	123	101	136	123	101
Havre, Montana (C)	226	204	270	226	204	270
Helena, Montana (A)	263	264	320	263	264	320
Houston, Texas (C)	0	0	0	0	0	0
Huron, South Dakota (A)	117	190	149	117	190	149
Indianapolis, Indiana (A)	77	90	79	77	90	79
Jackson, Mississippi (A)	0	17	0	0	17	0
Kansas City, Missouri (A)	25	29	44	25	29	44
Knoxville, Tennessee (A)	5	23	33	5	23	33
La Crosse, Wisconsin (A)	117	178	152	117	178	152
Landor, Wyoming (A)	193	267	244	193	267	244
Lewiston, Maine (O)	185	187	165	185	187	165

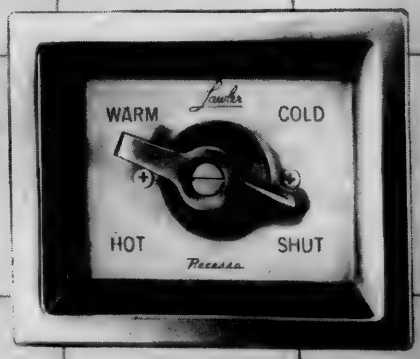
(a) Data not available.

Normal figures in this table are based on 30-year period covering 1921 to 1950, inclusive, as compiled and published by the U. S. Weather Bureau.

Figures in this table, with two exceptions, based on local weather bureau reports. Exceptions are Utica and Lewiston, figures for which are furnished through the courtesy of Coke Sales Department, Central New York Power Corp., Utica, N. Y., and Norman E. Ross, Bursar, Bates College, Lewiston, Me., respectively. [Table concluded on page 124]

safest...

most comfortable showering



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THERMOSTATIC SHOWER MIXING VALVE

- For Safety from Bodily Injury
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- Most Luxurious
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IT'S THE RECESSO

COMPLETELY RECESSED INTO THE WALL!

Another Quality Product of

THE *Lawler Line* OF THERMOSTATIC CONTROL VALVES

LAWLER AUTOMATIC CONTROLS, INC.
MT. VERNON, N. Y.

Degree-Days for September, 1958 (Concluded)

(A) Airport readings; (C) City office readings; (O) Readings at a point on outskirts of city

AIR CONDITIONING, HEATING AND VENTILATING's 31st Year of Publication of Monthly Degree-Day Data

City	September			Season to Sept. 30, incl., from Sept. 1		
	1958	1957	Normal	1958	1957	Normal
Lincoln, Nebraska (C)	45	76	79	45	76	79
Little Rock, Arkansas (A)	10	0	10	10	0	10
Los Angeles, California (C)	(a)	0	17	(a)	0	17
Louisville, Kentucky (A)	23	22	51	23	22	51
Lynchburg, Virginia (A)	34	65	49	34	65	49
Macon, Georgia (A)	0	22	0	0	22	0
Madison, Wisconsin (A)	137	197	137	137	197	137
Marquette, Michigan (C)	208	259	236	208	259	236
Memphis, Tennessee (A)	12	6	17	12	6	17
Meridian, Mississippi (A)	0	22	0	0	22	0
Milwaukee, Wisconsin (A)	133	193	134	133	193	134
Minneapolis, Minnesota (A)	108	184	157	108	184	157
Moline, Illinois (A)	93	136	96	93	136	96
Montgomery, Alabama (A)	0	17	0	0	17	0
Nashville, Tennessee (A)	16	10	22	16	10	22
New Haven, Connecticut (A)	98	87	93	98	87	93
New Orleans, Louisiana (C)	0	6	0	0	6	0
New York, New York (C)	39	47	39	39	47	39
Newark, New Jersey	37	54	47	37	54	47
Norfolk, Virginia (A)	7	9	9	7	9	9
North Platte, Nebraska (A)	110	183	120	110	183	120
Oak Ridge, Tennessee (C)	22	12	0	22	12	0
Oakland, California (A)	16	[illegible]	76	16	[illegible]	76
Oklahoma City, Oklahoma (A)	17	17	12	17	17	12
Omaha, Nebraska (A)	52	91	88	52	91	88
Parkersburg, West Virginia (C)	55	49	56	55	49	56
Peoria, Illinois (A)	72	70	86	72	70	86
Philadelphia, Pennsylvania (C)	33	40	33	33	40	33
Phoenix, Arizona (A)	0	0	0	0	0	0
Pittsburgh, Pennsylvania (C)	64	64	56	64	64	56
Pittsfield, Massachusetts (A)	222	205	213	222	205	213
Pocatello, Idaho (A)	174	166	183	174	166	183
Portland, Maine (A)	210	184	199	210	184	199
Portland, Oregon (C)	71	10	85	71	10	85
Providence, Rhode Island (A)	108	93	107	108	93	107
Pueblo, Colorado (A)	61	81	74	61	81	74
Raleigh, North Carolina (A)	23	38	10	23	38	10
Rapid City, South Dakota (A)	127	189	193	127	189	193
Reading, Pennsylvania (C)	57	64	57	57	64	57
Red Bluff, California (A)	3	10	0	3	10	0
Reno, Nevada (A)	155	116	165	155	116	165
Richmond, Virginia (A)	24	59	33	24	59	33
Rochester, New York (A)	140	158	133	140	158	133
Roswell, New Mexico (A)	38	10	[illegible]	38	10	8
Sacramento, California (C)	3	2	17	3	2	17
St. Joseph, Missouri (A)	44	54	49	44	54	49
St. Louis, Missouri (C)	28	17	38	28	17	38
Salt Lake City, Utah (A)	116	101	88	116	101	88
San Antonio, Texas (A)	0	0	0	0	0	0
San Diego, California (A)	0	0	24	0	0	24
Sandusky, Ohio (C)	67	95	66	67	95	66
San Francisco, California (C)	39	56	110	39	56	110
Sault Ste. Marie, Michigan (A)	273	318	298	273	318	298
Savannah, Georgia (A)	0	3	0	0	3	0
Scranton, Pennsylvania (A)	157	139	115	157	139	115
Seattle, Washington (C)	105	30	134	105	30	134
Sheridan, Wyoming (A)	210	248	239	210	248	239
Shreveport, Louisiana (A)	0	0	0	0	0	0
Sioux City, Iowa (A)	74	133	128	74	133	128
Spokane, Washington (A)	226	106	205	226	106	205
Springfield, Illinois (A)	59	72	56	59	72	56
Springfield, Missouri (A)	49	41	61	49	41	61
Syracuse, New York (A)	133	131	117	133	131	117
Toledo, Ohio (A)	117	145	102	117	145	102
Topeka, Kansas (C)	49	36	42	49	36	42
Trenton, New Jersey (C)	54	60	55	54	60	55
Tulsa, Oklahoma (A)	18	5	18	18	5	18
Utica, New York (O)	157	132	182	157	132	182
Valentine, Nebraska (A)	130	186	145	130	186	145
Walla Walla, Washington (C)	82	42	93	82	42	93
Washington, D. C. (C)	23	43	32	23	43	32
Wichita, Kansas (A)	35	35	32	35	35	32
Williston, North Dakota (C)	227	235	261	227	235	261
Winnemucca, Nevada (A)	198	153	180	198	153	180
Yakima, Washington (A)	192	82	150	192	82	150

For footnotes, see page 122.

Unusual and Standard Heating Problems

INDEECO Electric
Blast Coil Heaters
for Package Air Conditioners
for Duct Installation
INDEECO Electric Blast Coil Heater for Duct Installation Listed by Underwriters' Laboratories.
INDEECO Electric Blast Coil Heater for Package Air Conditioners.

Met with 22,621 Installations, 150—17,500,000 Watts

Package Units Sized to Your Specifications Save You Design and Layout Work, Field Time — Cover Many Industrial, as well as Conventional Applications

You are invited to write for INDEECO catalogs discussing a wide variety of special and standard heating problems.

A growing trend toward Blast Coil Heaters as sole or supplementary sources of heat; or for special applications, has been hastened by many advantages and new Indeeco developments.

These advantages include: (1) Dependable performance. (2) Substantial design and field savings. You may obtain packaged units to fit your special requirements at no extra cost whatsoever. (3) Special applications to unusual heating problems.

How Constructed

INDEECO Blast Coil Heaters come as complete package units in any size desired. Completely wired for connection to the power system, constructed and marked for installation in minimum time. THERMAL CUT-OUTS furnished with each unit. Terminal boxes are large. Knockout holes of proper size to conform with National Electric Code included in bottom of terminal box of duct heaters. Wide field experience has enabled anticipation of most installation problems and adequate provision for them in advance.

A Few Types of Service Rendered

(1) As primary source of heat in buildings. (2) For booster or supplementary heating. Example: Industrial plants in which central heating plant is shut down at night or on weekends — to heat offices of executives. (3) For ZONE temperature control—described fully in new INDEECO literature. (4) For industrial applications. Example: For a major oil refinery, seven pumping stations which have no attendants are heated by INDEECO Blast Coil Heater installations.

More Than 100 Installations in Rockefeller Center

Numerous installations for major companies, institutions and government projects throughout the U. S.

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Write or mail coupon below for INDEECO BLAST COIL HEATER CATALOGS. Kept on file, they may be useful in many special situations.

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NEWS OF THE MONTH

DETAILS SET

for ASHAE Annual Meeting and International Exposition. Seven technical sessions, three symposia.

The 65th Annual Meeting of the American Society of Heating and Air-Conditioning Engineers and the ASHE-sponsored 14th International Heating and Air Conditioning Exposition will commence in Philadelphia, Pa., on January 26, 1959. Registration headquarters will be in the Bellevue-Stratford Hotel. The exposition will be in Convention Hall.

Society Pres. E. R. Queer, director and professor of Engineering Research at Pennsylvania State University, University Park, is to open the Annual Meeting at 9 a.m. on Monday morning, January 26 when he will call to order the first session. This is to be a topical session on comfort, moderated by C. S. Leopold, Philadelphia member of ASHAE. The Exposition will officially open at 12 o'clock noon on Monday. The hours of the Exposition will be 12 noon to 10 p.m., Monday, Tuesday, and Wednesday, closing at 6:30 p.m. on Thursday, the final day of the Exposition.

The Program and Papers Committee, John Everetts, Jr., Philadelphia, chairman, has arranged for seven technical sessions, including the topical session on comfort, and symposia on hydronics, on heat pump performances, and on corrosion and water treatment.

Various committee meetings will be held on Saturday and Sunday prior to the official opening of the Annual Meeting. The ASHAE registration desk at the Bellevue-Stratford will open on Sunday. On Sunday afternoon the Philadelphia Chapter of the Society will be host at a Welcome-Pennsylvania Dutch *koffee klatch*.

The topical session on comfort, already attracting widespread interest, will bring together outstanding experts on the subject, including Dr. Thomas Bedford, London School of Hygiene and Tropical Medicine, England, Dr. Nello Pace, Department of Physiology, School of Medicine, University of California, and ASHAE Director of Research B. H. Jennings, who will present papers concerned with indoor environment and human comfort.

Papers selected by the Papers and Program Committee for presentation at the meeting are related to residential heating subjects, including location of basement heating supply outlets; pulsations in single-port, gas-fired equipment; and low frequency combustion noise in oil-burning units. Other topics are concerned with a new way to calculate radiant exchanges, the heat gain through windows shaded by metal awnings, and a probe for thermal conductivity measurement of dry and moist material.

The Annual Meeting is planned as follows: first session, Monday morning; second and third sessions, concurrently on Tuesday morning; fourth and fifth sessions, simultaneously on Wednesday morning; and sixth and seventh sessions, concurrently on Wednesday afternoon.

E. K. Wagner, general chairman of the Philadelphia Chapter Committee on Arrangements, announces a welcome luncheon on Monday attended by Richardson Dilworth, Mayor of Philadelphia, a get-together party on Monday evening, and the Annual Banquet on Wednesday evening. The committee is also developing such other special features as sightseeing tours and a fashion show for the ladies.

This million-dollar Engineering Center, built by National-U. S. Radiator Corp., at Johnstown, Pa., "provides the flexibility we need to develop and evaluate new designs in heating and air-conditioning equipment, as well as to explore such new and promising fields as heat pumps, and solar and electric heating", T. B. Focke, company president, told guests at the dedication ceremonies here on October 16th. Twelve-thousand square feet of unobstructed laboratory space in the raised section is occupied by air-conditioning test cells, boiler test stands, and related research activities. Picture windows in the offices around the perimeter of the 40,000 sq ft center overlook the dense woods adjacent to the 8-acre Research Park.

VENTILATION

for industrial and mining installations is topic of annual conference for designers and contractors.

A preliminary announcement of the 8th Annual Industrial Ventilation Conference to be held at The Kellogg Center for Continuing Education, Michigan State University, East Lansing, Mich., February 16-19, 1959 has been made by the University, which is co-sponsoring the Conference with the Division of Occupational Health of the Michigan Department of Health.

The Conference covers both industrial and mining ventilation, presenting practical, informative lectures and design problems for ventilation designers, contractors, and consultants. As before, workshop sections will offer introductory and advanced problems in industrial ventilation, including hood design, dust transport, tank ventilation, fans, and make-up air; as well as topics in mining ventilation design, including underground ventilation and dust control for ore handling and crushing.

Informal lectures and demonstrations will include: air flow fundamentals, testing of exhaust systems, fan selection and application, collector performance, and make-up air applications.

(News of the Month continued on page 128)

ROBERT S. STEVENSON

Portrait by Fabian Bachrach

"At Allis-Chalmers we believe that we can do our fellow-employees no greater favor than to recommend that they invest in a 'nest-egg' fund of U.S. Savings Bonds.

"While this program has been going on for many years—made easy through the Payroll Savings Plan—we recently offered all Allis-Chalmers people a chance to review their individual bond purchasing schedules and to bring them up to date.

"As a result, more than 52% of the total Allis-Chalmers organization of about 40,000 people are buying U.S. Savings Bonds at a rate of approximately $6,000,000 a year."

ROBERT S. STEVENSON, *President*
Allis-Chalmers Manufacturing Company

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The United States Government does not pay for this advertising. The Treasury Department thanks, for their patriotic donation, the Advertising Council and

Air Conditioning, Heating and Ventilating

TODAY—PAYROLL SAVINGS ENROLLMENT IS AT A NEW PEACETIME PEAK!

CONSTRUCTION INDUSTRY

will discuss trends in urban building. Authorities in esthetics, sociology, and engineering to be heard.

The Fourth National Construction Industry Conference will hear authorities present their views on the present and future trends in urban buildings. To be held in the Hotel Sherman, Chicago, Ill., December 10 and 11, the sessions are sponsored by Armour Research Foundation of Illinois Institute of Technology, American Institute of Architects, American Society of Civil Engineers, Associated General Contractors of America, and Building Research Institute.

Authorities in esthetics, sociology, psychology, architecture, building, engineering, and city planning will discuss human needs in cities of the future, according to R. T. Mijanovich, ARF mechanical engineering project coordinator and conference chairman. The opening session will stress human needs in urban society. The remaining three sessions will highlight responses from architects, engineers, and builders.

Inquiries concerning the conference should be addressed to M. J. Jans, Conference Secretary, Armour Research Foundation, 10 W. 35 St., Chicago 16, Ill.

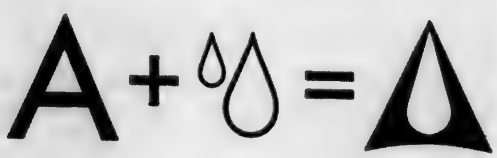
SURGEON GENERAL

to present report on first five years' operation of national air sampling network measuring air pollution.

Air conditioning engineers, among other interested parties, have been invited to attend the National Conference on Air Pollution, to be held November 18-20 at the Sheraton-Park Hotel in Washington, D. C. The conference will attempt to answer authoritatively, in addition to "What's in the air?", such questions as "Where does it come from?"; "What does it do to humans?"; "What are its costs to society?"; "What can be done about it?"

The Conference has been called by Dr. Leroy E. Burney, Surgeon General, Public Health Service, U. S. Department of Health, Education, and Welfare. He will present a "status report" on the progress to date of the five-year program of research and technical assistance to States on air pollution problems which was authorized by Congress in 1955. This will include a report on the National Air Sampling Network which has been set up in cooperation with the States and communities.

The Sampling Network is the first attempt to collect and analyze air pollution data on a nation-wide basis. It already covers 112 urban sites and 45 others outside of cities, where samples are collected for analysis at the Public Health Service's Sanitary Engineering Center at Cincinnati.



W. D. Allen Mfg. Co., 71 year old Chicago manufacturer of fire protection equipment and lawn sprinklers has adopted a new trademark. It was developed in the course of redesigning the company's oscillating sprinkler. Design was arrived at by combining the outline of a capital "A" for Allen with the outline of a drop of water.

PRODUCTION DOUBLES

for gas-fired heavy-duty forced air heater, industry association reports, reflecting upgrading of heating.

Industry's increasingly close attention to heating and ventilating problems is credited in large part for doubling of gas-fired, heavy-duty, forced air heater production in the past two or three years, according to the Gas Appliance Manufacturers Association (GAMA).

In establishing a new division this year for heavy-duty forced air, GAMA defined such equipment as direct-fired heaters, or heat diffusers, with capacity in excess of 500,000 Btu per hr output. Their primary use is for comfort heating in buildings having a wide expanse of open space or where rapid air changes are likely.

Heaters in this category using gas, or gas in combination with oil, probably will account for a 1958 production total aggregating well over three billion Btu output, according to GAMA. This total is termed approximately double that of two or three years ago. Increasingly large combinations, aggregating millions of Btu of unit capacity, are being installed. One Western Steel plant has an installed capacity of 70,000,000 Btu.

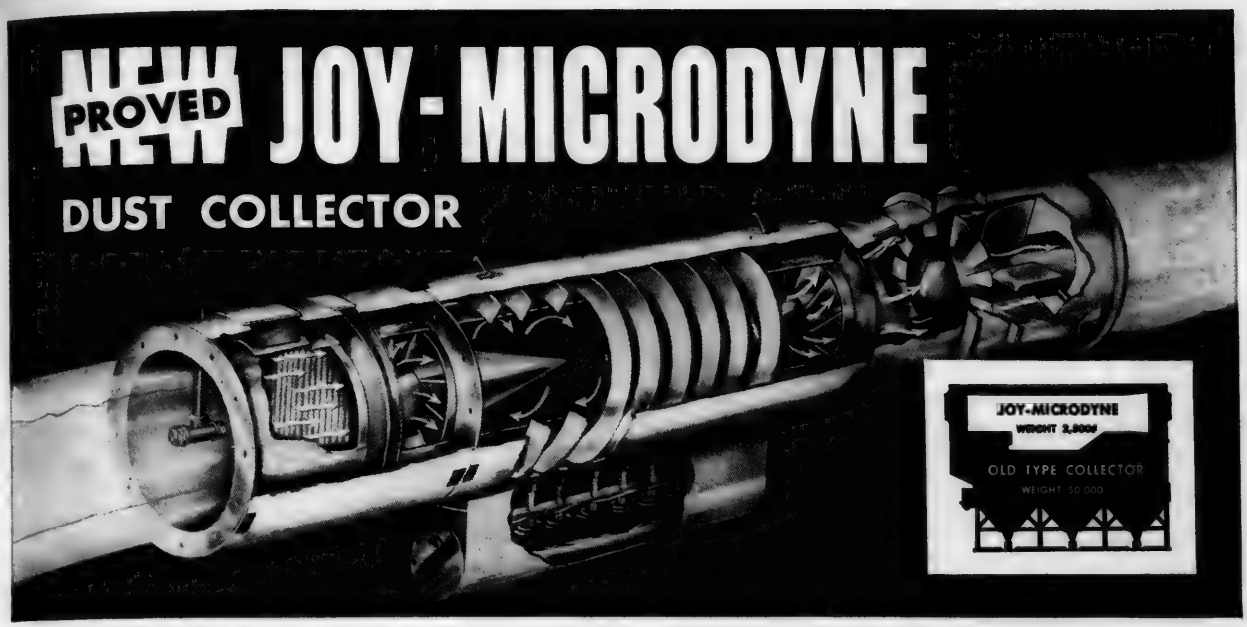
• **APPLICATIONS NUMEROUS**—The most common installations are without ducts, with the heaters lining the walls of the building and sending high-velocity heated air into working zones in a line parallel with the floor and from a height about 10 ft above it. Air is drawn back to the base of the heater at velocities low enough to avoid drafts.

The floor-positioned, ductless arrangement may be most common but is by no means exclusive. Newest summaries of installations show a great variety of arrangements, ranging from the simple duct carrying heated air to a small office to the complex heat distribution arrangements for schools, libraries, and exposition halls. Some of the division members report a decided rise in demand for the heaters for recreation projects—bowling alleys, skating rinks, and the like.

• **AIR TEMPERING**—Heaters may distribute 100% outside air, recirculated inside air, or any combination of the two. Division members report increasing emphasis on air tempering operations, in which large quantities of heated air are supplied to replace that used to carry off dust or fumes. Modulating controls permit free selection of the temperature to which outdoor air is to be heated. Sometimes, when machinery is generating heat, air will be brought in at a level below that of the desired indoor temperature. Frequently more heating is found to become necessary when new equipment—for instance, a more efficient kiln—is installed.

(Continued on page 142)

NEW PROVED JOY-MICRODYNE DUST COLLECTOR



Profile of a Problem Solver

Here is an in-duct "educated pipe" that laughs at space, weight and water limitations as it collects over 99% of dust 5 microns and larger; 92% of 2-micron dust, and substantial amounts of smaller dust.

Particles enter through water-saturated air, slam against a water-film-covered impingement element, encase themselves in water droplets as they pass through, then whirl and collect on the sides of the middle section, to finally drain into a sump. Cleaned air is straightened and thrust on its way by an integral Joy Axivane Fan.

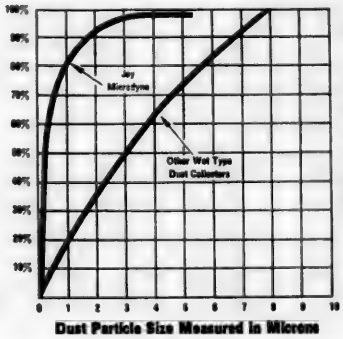
SAVES SPACE—Installs as an integral section of ductwork; requires only 1/10 to 1/20 the space of conventional units. 2500 cfm unit is 10 feet long; 1.5 feet in diameter.

SAVES WEIGHT—Even the largest unit—64,000 cfm, 5 feet in diameter, 32 feet long—weighs only 6,500 pounds . . . or 1/5 the weight of conventional collectors. 2,500 cfm unit weighs only 325 pounds.

SAVES WATER—The largest Joy collector requires only 48 GPM flow—much less than comparable wet collectors. Add a Delpark Filter (Sold by Joy) and water can be recirculated to recover valuable dusts. The filter also reduces water borne solids to give a dependable, clear water supply from a dirty water source.

SUCCESSFUL INSTALLATIONS—Joy collectors from 500 cfm through 64,000 cfm are *now in use* collecting such widely varied dusts as hemitite, copper and uranium ores, coal, quartz, limestone, phosphate, stainless steel and titanium carbide grindings. For answer to your dust collecting problems, write, wire or call: ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** *In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

This 48,000 cfm installation shows compact assembly and space economy of in-duct placement.



Performance graph of actual installation shows efficiency of the Joy-Microdyne Dust Collector. (A micron is 1/25,000 inch)

WSW I 7002-231

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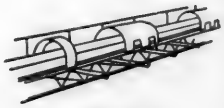

Conveyors

Industrial Compressors

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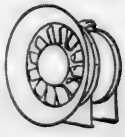

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Made of strong neoprene coated cotton or nylon fabrics spiral wire reinforced.
For *all* kinds of fume and dust control, and ventilation uses.
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Exceptionally easy to cut, install, connect, reuse, and relocate.
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NEW CATALOGS

Use the prepaid postcard on last page for securing your copies of catalogs described in this department.

CENTRIFUGAL REFRIGERATION — Worthington Corporation, Harrison, N. J., announces a new bulletin on the subject of centrifugal refrigeration. Featuring the company's two-stage centrifugal refrigeration compressors, the 28-page bulletin includes their features, evaporator and condenser specifications, and description of allied equipment.

Circle **Item 58** on Inquiry Card

DOUBLE DUCT CONTROL UNIT — A 4-page bulletin, No. F-8753, from Barber-Colman Co., Rockford, Ill., describes the company's Uni-Flo Model CV double duct control unit. It contains diagrams, dimensions, specifications, and performance data, including noise level in decibels.

Circle **Item 59** on Inquiry Card

COIL SELECTION — A kit, available from Carrier Corp., Syracuse, N. Y., is said to save hours of time in selecting central station air conditioning equipment. Key to the selection procedure is a chart for converting entering and leaving air wet bulb conditions to the apparatus dewpoint (ADP), or the effective surface temperature of the exact coil for the job. From this data, circuiting of the coil, its water quantity and pressure drop can be picked from rating tables in a 72-page catalog for the company's two new lines of central station units. Kit includes catalog, pads of conversion charts, and special data pads.

Circle **Item 60** on Inquiry Card

WELDING SUPPLIES, ACCESSORIES — A 52-page catalog, ADC-848C, on welding supplies and accessories is available from Air Reduction Sales Co., a division of Air Reduction Co., Inc., New York, N. Y. Booklet covers the company's complete line of fluxes and ferrous and non-ferrous rods for gas welding, and accessory items for both arc and gas welding.

Circle **Item 61** on Inquiry Card

COMPACT WATER-TUBE BOILERS — The Vapor Drum Modulatic boiler, a compact water-tube unit, is the subject of 4-page Bulletin 475, available from the manufacturer, Vapor Heating Corp., Chicago, Ill. Bulletin gives complete specifications and a schematic diagram showing operation of unit.

Circle **Item 62** on Inquiry Card

INSULATION ADHESIVES, SEALERS — A 4-page catalog, describing adhesives for bonding insulation and insulating sealers, is available from Adhesives, Coatings and Sealers Div., Minnesota Mining and Manufacturing Co., Detroit, Mich. Properties, uses, application methods, and coverage are listed in chart form.

Circle **Item 63** on Inquiry Card

HIGH VELOCITY EQUIPMENT—Connor Engineering Corp., Danbury, Conn., offers 24-page Bulletin K33-A which describes the company's Series 45 high velocity valve attenuators. Technical information on sound control, duct design methods, and proper selection of units is given; comprehensive graphs, diagrams, and charts are provided.

Circle **Item 64** on Inquiry Card

MECHANICAL DRAFT FANS—A catalog, titled Mechanical Draft Fans, is offered by Westinghouse Electric Corp., Boston, Mass. The 8-page brochure describes the company's Series 7000 centrifugal fans, which are designed for handling abrasive gases at elevated temperatures. Complete application, performance, and physical data are given, as well as a list of optional accessories.

Circle **Item 65** on Inquiry Card

STEAM METERING — Accurate steam metering for 1½-inch lines is the subject of eight-page Bulletin 400-P25, issued by Builders-Providence, Inc., a division of B-I-F Industries, Inc., Providence, R. I. It describes features, operation, installation and specifications of the company's improved shunt-flo meter, designated as Model SMDH Style 57, which has been simplified for more efficient replacement of orifice plates to change capacity.

Circle **Item 66** on Inquiry Card

SUSPENDED GAS-FIRED FURNACES — The company's new line of Shafconaire suspended gas-fired furnaces is covered in a folder offered by Over-Head Heaters, Inc., Detroit, Mich. It describes four features and three models of the commercial-industrial unit.

Circle **Item 67** on Inquiry Card

CENTRIFUGAL COMPRESSORS—A 20-page bulletin, No. 909, describing the company's greatly expanded line of centrifugal compressors, is available from American-Standard, American Blower Division, Detroit, Mich. The bulletin describes construction and operating features of the units and lists typical applications. Ratings, based on ASME Test Code Standards, are presented for typical pressure-volume-horsepower selections in the range of pressure and volumes most frequently encountered.

Circle **Item 68** on Inquiry Card

CARRIERS AND CLOSET FITTINGS — Josam Manufacturing Co., Michigan City, Ind., announces Manual FG, a 4-page bulletin describing the company's line of Unitron carriers and closet fittings for wall-hung fixtures. Application illustrations are an aid in selection.

Circle **Item 69** on Inquiry Card

HOT WATER HEATING CIRCULATOR— A catalog sheet published by Triplex Heating Specialty Co., Inc., Peru, Ind., describes the company's hot water heating circulator. Performance data and a table of capacities and dimensions are presented, in addition to installation diagrams.

Circle **Item 70** on Inquiry Card

GAS-FIRED UNIT HEATERS — Gas-fired unit heaters, manufactured by Grinnell Corp., Providence, R. I., are rated by sound classifications. Catalog 58 covers these ratings as well as unit location, mounting heights, length of throw, performance specifications, and weights and dimensions.

Circle **Item 71** on Inquiry Card

SWIMMING POOL ACCESSORIES — Fabro Equipment Corp., New Brunswick, N. J., adds to its product line pool building and operating accessories. Catalog from the company describes this equipment, including underwater lights, bottom drains, pool vacuum cleaners, ladders, and swimmers, which is designed to withstand long contact with both fresh and salt water.

Circle **Item 72** on Inquiry Card

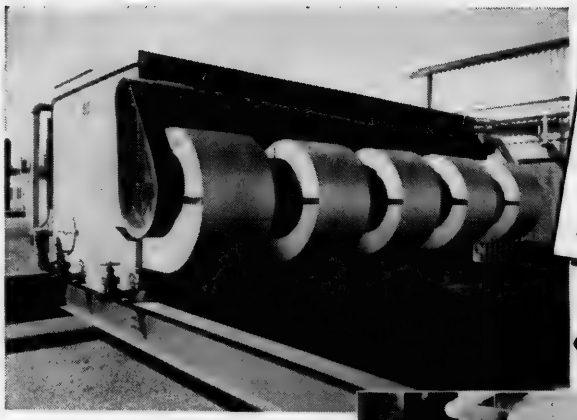
CONDENSING UNITS—A 4-page bulletin from Lehigh Manufacturing Co., Div. of Lehigh, Inc., Easton, Pa., covers the company's line of Blu-Cold condensing units. Capacities and specifications are given for air-cooled, water-cooled, and combination air- and water-cooled units.

Circle **Item 73** on Inquiry Card

HEATING CONTROLS — Four-page Bulletin GEA-6774, published by General Electric Co., Schenectady, N. Y., contains descriptions and application information on the company's complete line of domestic heating controls, including thermostats, an outdoor control system, flame detectors, fan and limit switches, transformer relays, master (safety) controls, and warm air, steam pressure and hot water limit controls.

Circle **Item 74** on Inquiry Card

Use the prepaid postcard on last page for securing your copies of catalogs described in this department.

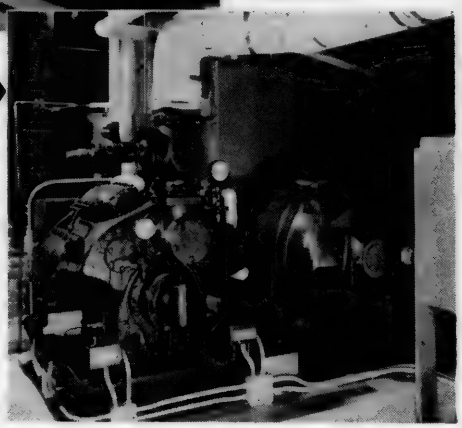


View of the Vilter VXF evaporative condenser located on the roof just outside the compressor room.

Vilter Report Card

Grade	Service Record
A	Efficient, alternating zone-load operation.
A	Exceptionally low operational cost.
A	Uninterrupted air conditioning service.
A	Smooth operation with minimum maintenance.

View of one of the two Vilter 8-cylinder VMC Freon compressors with a 100 h.p., 1175 r.p.m., part winding motor drive. These compressors are located on an upper floor, above an office.



Cool Thinking ... Cool Fun in Marquette University's Air Conditioned Brooks Memorial Union

Brooks Memorial Union is the hub of many Marquette University activities—professional meetings and conferences attracting a national audience, exciting school dances, excellent food facilities in the cafeteria, snack bar and private dining rooms. One key to its year-'round popularity and usefulness is the air conditioned comfort provided by the Vilter installation on this Milwaukee Campus.

To provide adequate air conditioning on a conservative appropriation and to minimize yearly operating expenses, the system was laid out to provide alternating zone-load cooling based on a "traffic flow" and usage pattern. During normal occupancy the entire Union is cooled. However, at peak loads only part of the conditioned space in Brooks Memorial is cooled at one time. As the peak occupancy load shifts from cafeteria and grill to the ballroom-conference room, the air conditioning is also shifted. Results of operating in this manner have been highly satisfactory.

Vilter equipment furnished on this job included two 8-cylinder VMC compressors; VXF Freon evaporative condenser; Freon liquid receiver; heat exchanger, cooling coils, motors, and controls.

"Very satisfactory performance with only routine maintenance," is the praiseworthy comment by Marquette University officials.

Let Vilter help you with your air conditioning and refrigeration requirements.

Write for these helpful bulletins to: The Vilter Manufacturing Company Dept. G-804, 2217 S. First Street, Milwaukee 7, Wisconsin

Bulletin 631 Vilter Uni-Chiller

Bulletin 820 Vilter VMC Freon Compressors

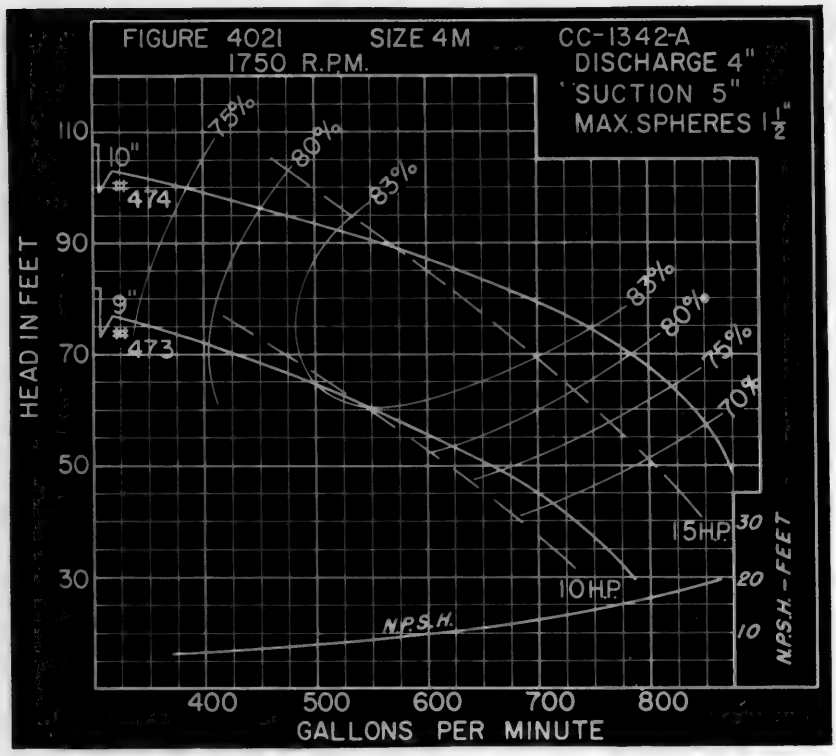
Bulletin 732 VXF—VSC Evaporative Condensers

Vilter®

REFRIGERATION and AIR CONDITIONING

THE VILTER MANUFACTURING COMPANY, Milwaukee 7, Wisconsin

Air Units • Ammonia & Freon Compressors • Booster Compressors • Baudelot Coolers • Water & Brine Coolers • Blast Freezers • Evaporative & Shell & Tube Condensers • Pipe Coils • Valves & Fittings • Pakice & Polarflake Ice Machines



DEMING PUMPS

provide maximum performance and efficiency

Deming pump engineers are prepared to offer technical assistance on the applications of the complete line. Specific data graphically illustrates the characteristics that accurately determine the ultimate performance and efficiency of proposed pump installations.

For details or technical assistance write: Engineering Dept.

THE DEMING CO.

558 BROADWAY • SALEM, OHIO

NEW CATALOGS

Use the prepaid postcard on last page for securing your copies of catalogs described in this department.

SCOTCH-TYPE BOILER—Literature on its scotch-type low pressure boiler for big installations is available from Portmar Boiler Co., Inc., Brooklyn, N. Y. Four-page brochure gives construction details, capacities and dimensions.

Circle **Item 75** on Inquiry Card

REGISTERS AND GRILLES—Engineering Manual No. 39, published by Universal Diffuser Corp., Tuckahoe, N. Y., describes and illustrates the company's lines of registers and grilles. Also included in the 23 pages are construction details, screw hole locations, general engineering data, and comprehensive selection tables.

Circle **Item 76** on Inquiry Card

COIL-TYPE SPRAY DEHUMIDIFIERS — A revised bulletin, No. 37, on coil-type spray dehumidifiers is published by Marlo Coil Co., St. Louis, Mo. Twice the size of the previous version, the 16-page bulletin includes engineering data, dimensional data, coil performance charts, and a psychrometric chart.

Circle **Item 77** on Inquiry Card

CHEMICAL PROCESS EQUIPMENT — Bulletin No. 16, in 16 pages, contains descriptions and specifications of the complete line of chemical process equipment manufactured by The Patterson-Kelley Co., Inc., East Stroudsburg, Pa. It also describes the organization and operation of the company's Pre-Test Laboratory which, in testing customer formulations, helps determine proper blending equipment and correct blending procedures.

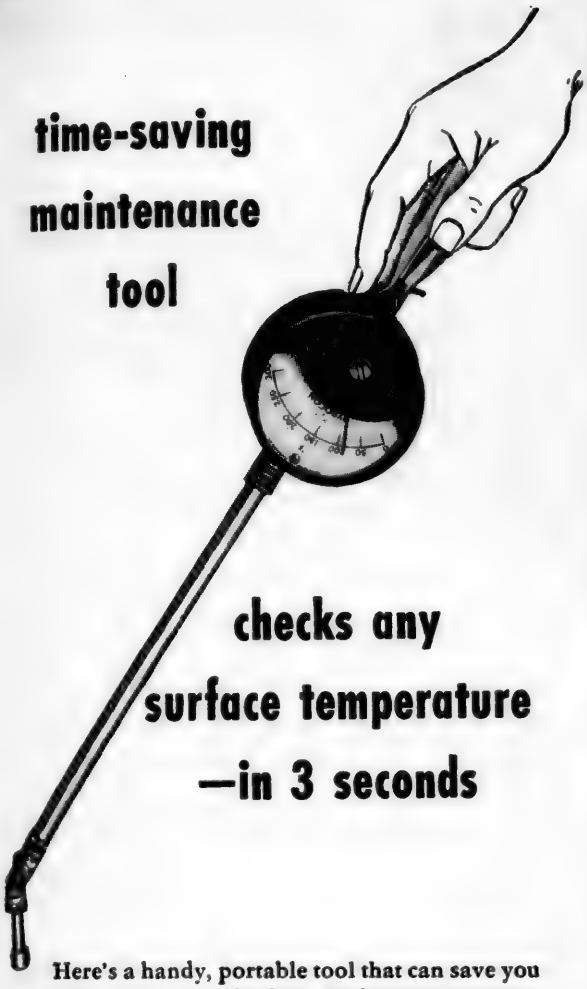
Circle **Item 78** on Inquiry Card

YEAR-ROUND ROOM UNITS—A catalog on Roomaire conditioners is available from the manufacturer, Young Radiator Co., of Racine, Wis. In addition to illustrations and descriptions of the remote-type year-round room units, the booklet includes capacity data, physical data and dimensions.

Circle **Item 79** on Inquiry Card

(Continued on page 134)

time-saving maintenance tool



checks any surface temperature —in 3 seconds

Here's a handy, portable tool that can save you hours of time in checking surface temperatures of steam traps, water lines, electric motors, bearings, etc.

The Alnor Pyrocon gives instant, accurate temperature readings of any surface: metallic or non-metallic, flat, curved—even revolving surfaces. It's a well-balanced instrument mounted in a sturdy case for protection against the usual hazards of on-the-job service. Jeweled movement is also heavy-duty, shock-resistant type that will withstand hard and continuous use...performing with laboratory accuracy.

A wide selection of thermocouples and extension arms assures its adaptation to your needs. Eight standard F. scale ranges are available up to 2000° F. Send for complete details contained in Bulletin 4257. Illinois Testing Laboratories, Inc., Room 514, 420 N. LaSalle St., Chicago 10, Ill.

PRECISION INSTRUMENTS FOR EVERY INDUSTRY

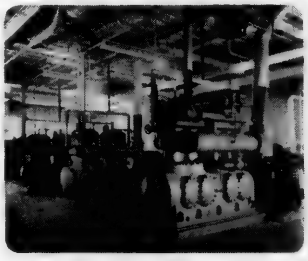
Alnor®

MODERNIZING?

Check FRICK Refrigeration **FOR ALL YOUR NEEDS**

- ☑ CONDENSERS
- ☑ PIPE COILS
- ☑ SHELL-ICE MAKERS
- ☑ VALVES & FITTINGS
- ☑ ICE RESERVE UNITS
- ☑ AIR HANDLING UNITS
- ☑ SHELL & TUBE COOLERS
- ☑ "ECLIPSE" COMPRESSORS
- ☑ HEAVY-DUTY COMPRESSORS
- ☑ QUICK-FREEZING SYSTEMS
- ☑ "INSTANT" WATER COOLERS
- ☑ MULTI-STAGE COMPRESSOR SYSTEMS
- ☑ LOW PRESSURE REFRIGERATION UNITS
- ☑ AUTOMATIC CONTROLS & DEFROSTING SYSTEMS
- ☑ ☑ COMPLETELY ENGINEERED SYSTEMS, DELIVERED AND INSTALLED

Frick Evaporative Condensers Save Up to 95% of the Water Used.



Frick Heavy-Duty Four Cylinder Compressors Can Be Adapted to Handle Any Type of Refrigerant.

Frick Shell-Ice—Clear Solid Pieces of Curved Ice. Made Automatically, Without Snow or Waste.

It is a proven fact that today's semi- and full-automatic equipment soon saves enough to pay for itself.

Whatever the refrigeration requirements of your plant—quick freezing, ice making, cold storage, humidity control, low temperatures, condensing, air conditioning, or any process cooling . . . Frick engineers will help you modernize your present system or design one to meet your needs.

Frick refrigeration equipment is world renowned for a long trouble-free life of dependable operation. Many Frick compressors have been in operation for over 40 years.

CALL your nearest Frick Branch or Distributor today. Or write direct to...

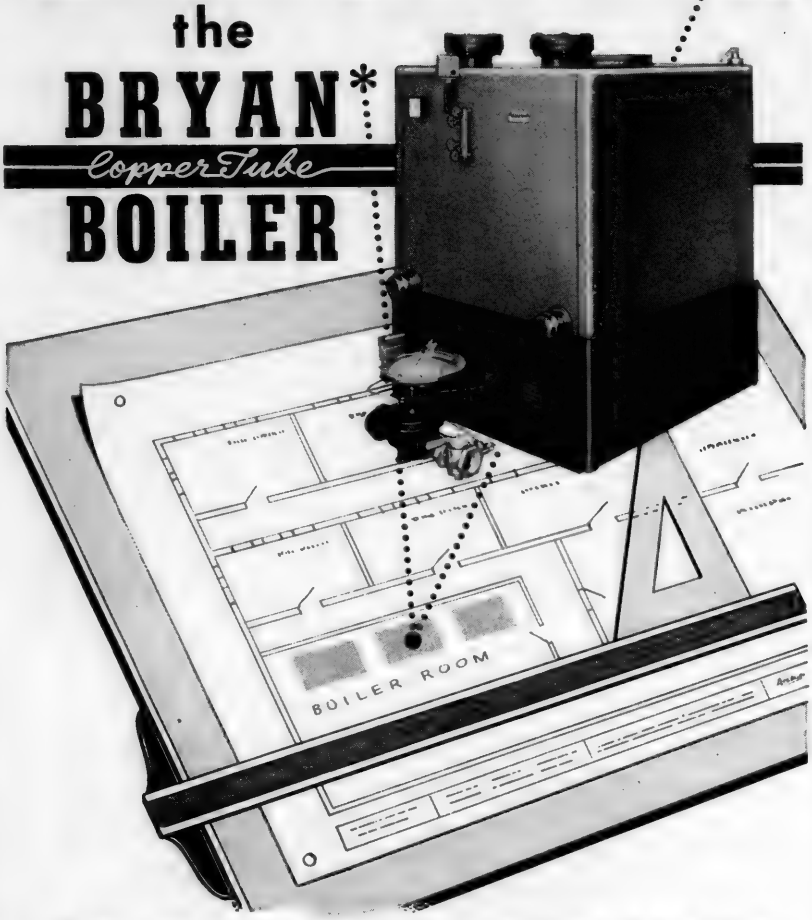
DEPENDABLE REFRIGERATION SINCE 1882

FRICK CO.

WAYNESBORO, PENNA., U.S.A.

to FIT the JOB*

the BRYAN* Copper Tube BOILER



For every steam or water heating application up to 1,800,000 B.T.U. output.

Whether the plans on your boards are for a factory, apartment house, swimming pool or a modest radiant heat home, a detailed check on specifications will point to one of the many Bryan models covering low or high pressure steam, hot water boilers, or indirect water heaters.

The Bryan is a heavy duty, durable boiler made to deliver a lot of B.T.U's in a short period of time. Specially engineered for gas or oil heating, its high efficiency is complemented by years of trouble free service. Requires minimum floor space.

Bryan is the originator of the famous Bryan copper tubes. They are used in both direct and indirect heating units for fast action and elimination of scale deposits.

Bryan Gas Fired Boilers are designed and built to the requirements of the A.S.M.E. code and are also approved by the American Gas Association (A.G.A.)

Send For Technical Information • 2100 Chili Pike

BRYAN STEAM CORPORATION • Peru, Indiana

NEW CATALOGS

(Continued from page 132)

Use the prepaid postcard on last page for securing your copies of catalogs described in this department.

FEEDWATER EQUIPMENT DESIGN — An article, Feedwater Equipment Designs and Methods, is available from Graver Water Conditioning Co., New York, N. Y. This paper, Technical Reprint T-161, discusses in detail the two main methods of treating boiler feedwater for industrial applications: hot process-hot zeolite and demineralization.

Circle **Item 80** on Inquiry Card

LP-GAS APPLIANCES—A 6-page bulletin, plus a price supplement, is available from Linde Co., a division of Union Carbide Corp., New York, N. Y. Literature describes the company's line of Prest-O-Lite LP-gas appliances including torch stems, torch handles, pressure regulators, and a melting furnace.

Circle **Item 81** on Inquiry Card

PERIMETER DUCT SYSTEMS—Diagrams and pictures illustrating the installation of Transite air duct for modern perimeter heating and cooling systems are shown in a brochure from Johns-Manville Sales Corp., New York, N. Y. Included is information on the different kinds of perimeter systems for slab-on-grade homes, without basement, and multi-level homes.

Circle **Item 82** on Inquiry Card

GAS-FIRED UNIT HEATERS—An 8-page publication, No. 400-1, offered by John J. Nesbitt, Inc., Philadelphia, Pa., describes the company's propeller fan type, sound rated, Series K gas-fired unit heaters. It contains details of construction and operation, in addition to dimensions, performance data, and application data.

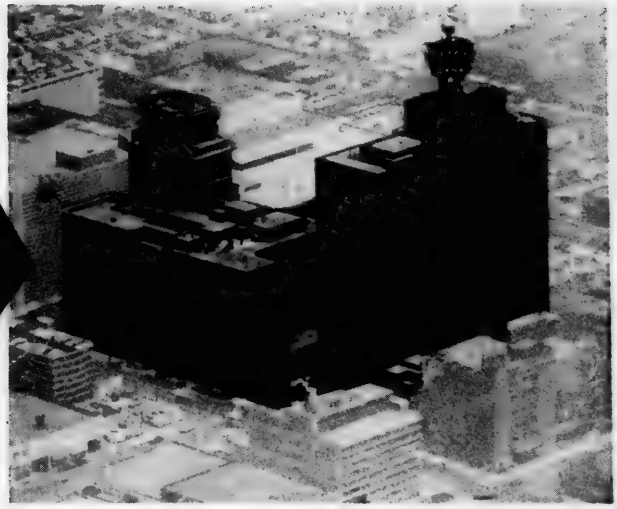
Circle **Item 83** on Inquiry Card

COMPACT DUST COLLECTOR—A 12-page bulletin describing the company's compact Microdyne dust collector is published by Joy Manufacturing Co., Pittsburgh, Pa. Bulletin J-616 contains performance curves, specifications, and cutaway drawings of the wet inertial type unit's inner construction.

Circle **Item 84** on Inquiry Card

(Continued on page 136)

Major Oil Company SPECIFIED THERMAL



Two big Thermal central plant units were specified by a major oil company with headquarters in Houston for the year-round air conditioning of its Data Processing System. This same company has many other installations of Thermal air conditioning equipment in its several plants and office facilities.

The Thermal line includes central plant air conditioners; multi-zone air conditioners, sprayed coil units; heating and ventilating units, cooling and heating coils and air-cooled condensers. For air conditioning and ventilating equipment that can be relied on for efficiency, long life and economical operation, see your Thermal Engineering agent.

See our exhibit at the 14th International Heating & Air Conditioning Exposition, Convention Hall, Philadelphia, January 26-29, 1959, Booth #16.

THERMAL ENGINEERING CORPORATION

2605 W. DALLAS • P. O. BOX 13254
HOUSTON 19, TEXAS

from Webster... NEW SUPPLY PUMP EQUIPMENT

to handle no. 5 and 6 furnace oils

Webster direct drive units are motor driven at 900 rpm optimum speed — relatively low speed lengthens pump life. Capacities and pressures of belt driven sets can be varied to meet specific requirements by changing size of pulleys.

Now the efficiency and high operating performance of Webster supply pumps are available for commercial and industrial applications requiring the handling of heavy oils. The new Webster heavy oil pumps are built in either direct drive or belt drive units with motors ranging from ¼ h.p. to 2 h.p. Plenty of capacity, too ... from 28 to 575 gph, with pressures up to 300 psi. Extra large ports mean initially cold, heavy oils can be handled without restrictions.

New Webster pumps are compact, easy to install — require less plumbing. Catalog A10A1 gives complete specifications and mounting dimensions. Write for your copy today.

call the man from Webster

HEATING DIVISION
WEBSTER ELECTRIC
RACINE · WIS

installing SIMPLEX

The only completely integrated radiant-acoustical ceiling for

• economy • comfort • efficiency

The environmental control "package" you have been looking for.
This ceiling does the complete job of heating, cooling and ventilating with one medium—air, while providing acoustical insulation, attractive concealment for overhead services and support for recessed lights.

Economy
- Smaller ducts and fans due to a ⅓ saving in air quantities.
- Permanent aluminum ceiling finishes.
- Air diffusers eliminated.
- Rapid, *one trade* installation.

Comfort
By using only air, SIMPLEX combines:
- the speed of response of forced air systems, with
- the superior comfort of radiant heating and cooling.

Saves Space
- Smaller ducts allow shallower plenum spaces. *Saves on building height.*
- All floor space is free for use by building occupant.

Also—no SIMPLEX radiant-acoustical ceiling has ever caused condensation!

Send today for folder with complete specifications, photographs, and details. Simplex Ceiling Corp., 552 W. 52 St., New York 19, N.Y.

SIMPLEX
Ceiling Corp.
552 West 52 St., New York 19, N. Y.
Please send me folder describing the Simplex all air radiant-acoustical ceiling.
Name.....
Firm.....
Address.....
City.....Zone...State.....

NEW CATALOGS

(Continued from page 134)

Use the prepaid postcard on last page for securing your copies of catalogs described in this department.

DIRECT-FIRED UNIT HEATERS — Design and operating features of counterflow design, direct-fired unit heaters are given in a 6-page bulletin offered by Jackson & Church, a division of York-Shipley, Inc., York, Pa. Dimensions and performance data are included in the booklet.

Circle **Item 85** on Inquiry Card

COMPLETE LINE OF PUMPS—A complete line of condensate, turbine, boiler feed, centrifugal, and proportioning pumps, as well as fuel oil pump and heater sets, is described and illustrated in a bulletin offered by Walter H. Eagan Co., Inc., Philadelphia, Pa.

Circle **Item 86** on Inquiry Card

PROCESS INSTRUMENTATION—Representative items from the wide lines of process instrumentation and equipment manufactured by B-I-F Industries, Inc., of Providence, R. I., are described in an 8-page bulletin, No. 100-R5, offered by the company. It contains photographs, operational data, and descriptions of twelve varied products for positive control of materials in motion.

Circle **Item 87** on Inquiry Card

DRY FLUID DRIVES—An expanded line of Flexidyne dry fluid drives and couplings is described in 24-page bulletin published by Dodge Manufacturing Corp., Mishawaka, Ind. Complete with product photographs and engineering drawings, it explains how this device solves many difficult drive problems. Bulletin includes tables to facilitate selection for normal and heavy-duty service.

Circle **Item 88** on Inquiry Card

INDUSTRIAL PETROLEUM PRODUCTS—A booklet from Industrial Products Dept., Sun Oil Co., Philadelphia, Pa., gives information on the company's complete line of industrial products, including general and specialty lubricants, greases, diesel lubricating oils, metalworking oils, hydraulic oils, heat-transfer oils, solvents, and refrigeration oils.

Circle **Item 89** on Inquiry Card

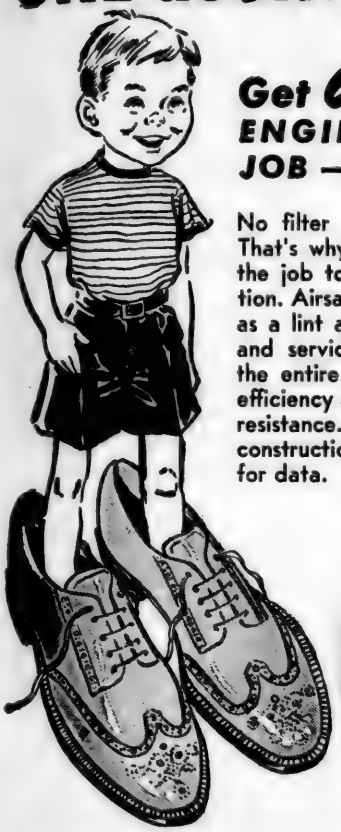
(Continued on page 138)

a good team for steam

This Yarway team has scored high—over a million installed on all types of steam equipment. Stocked and sold by 270 Industrial Distributors. For free Steam Trap Book, write YARNALL-WARING CO., 104 Mermaid Ave., Philadelphia 18, Pa.

go YARWAY with confidence

ONE doesn't fit ALL needs!



Get *Airsan* Filters
ENGINEERED TO FIT THE JOB — RIGHT EVERY TIME

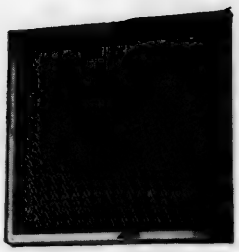
No filter does all jobs, meets every need. That's why Airsan Filters are engineered to the job to offer more effective dust collection. Airsan's expanded metal face plate acts as a lint arrestor to provide easier cleaning and servicing. It distributes air easily over the entire filter area. Provide high filtering efficiency and dust holding capacity with less resistance. Features include all galvanized construction and welded lock corners. Write for data.

Send for Free Bulletins

AFI MEMBER AIR FILTER INSTITUTE

AIR FILTERS
(Low Velocity)

Viscous type, permanent and cleanable designed for industrial, commercial and domestic use. Available in 1" and 2" thickness.

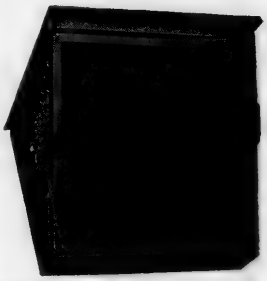


VIRO-CRIMP
(High Velocity)

Has a specially designed high velocity Viro-Crimp filter core. Hemmed edges provide a safety feature. Operates efficiently at 300 to 500 fpm. Available in 2" and 4" thickness.

GREASE FILTERS

Permanent, cleanable type Airsan Grease Filters made especially for range canopies, galleys, kitchens. Available in 2" thickness.



Air Filter Corporation

4554 S. West Woolworth Ave. • Milwaukee, Wis.

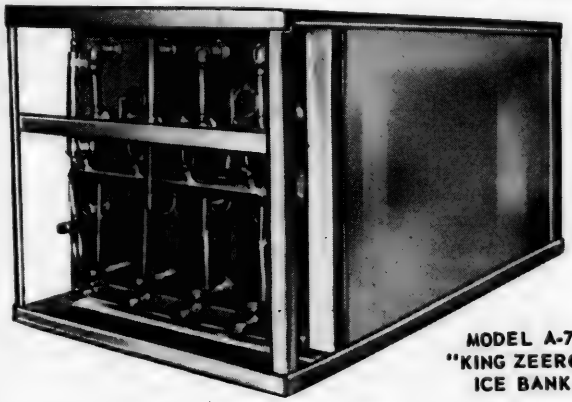
Canadian Representative

DOUGLAS ENGINEERING CO., LTD., TORONTO

A Few Distributorships Available. Write for Details!

Add a *"King Zeero"* ICE BANK to Your Refrigerating System for Effectual, Economical Air Conditioning

The "King Zeero" ICE BANK is designed to deliver 32° to 34°F. ice water for recirculation through air cooling coils in exactly the right amount when and where it is needed. It levels off "peak" and "valley" loads. Peak loads many times compressor capacity are easily handled. Ice Banks may be added to increase existing capacity. Refrigerant: Freon, Methyl Chloride or Ammonia.



MODEL A-7
"KING ZEERO"
ICE BANK

CAPACITIES - 500 lbs. to 30,000 lbs. (72,000 B.T.U.'s to 4,320,000 B.T.U.'s) in a single unit. Multiple units may be installed.

The Patented Coils with Built-in Louvres opposed to the flow of water through the ICE BANK provide turbulence. This eliminates a mechanical agitator - insures all the water rubbing all of the ice. No upkeep or repair expense whatever.

The "King Zeero" Ice Storage System of water chilling has definite advantages over direct expansion, or other types of ice accumulators.

Saves power through smaller compressor requirement. Simple construction (no moving parts). Dependable in performance. Low operating and costs.

Let the ice stored during light loads take care of peak loads. The compressor need only handle the average daily load - not the peak.

THE KING ZEERO COMPANY

4300-14 W. Montrose Ave. - Chicago 41, Ill.

Manufacturers of Ice Builders - Ice Builder Cabinets - Ice Banks

NEW CATALOGS

(Continued from page 136)

DOUBLE-DUCT CONTROL SYSTEMS — The purpose of a booklet published by Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., is to describe and analyze the characteristics of two current approaches to the control of high-velocity, double-duct air conditioning. One system uses a single pressure regulator to control the total output of mixed air; the other uses two pressure regulators to control output of the individual hot and cold ducts.

Circle **Item 90** on Inquiry Card

EVAPORATIVE CONDENSERS — Reprints of an address on "Evaporative Condensers" given by the vice president and chief engineer of Recold Corp., Los Angeles, Calif., are available from the company.

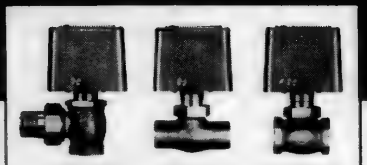
Circle **Item 91** on Inquiry Card

AXIAL FLOW FANS—A 4-page bulletin, No. 5802, available from Pesco Products Div., Borg-Warner Corp., Bedford, Ohio, describes company's line of axial flow fans which provide high air displacement and pressure for cooling, heating and ventilating. Specifications are included.

Circle **Item 92** on Inquiry Card

for satisfied customers and more sales volume.

sell
ZONVALVE
the best in modern
ZONED HEAT



Model RS-A Model C-S Model S-S

ZONED HEAT means:
more comfort, less fuel!

Zoned heat is now recognized as the ultimate in modern heating. Its advantages are two-fold:

1) *Comfort* – each area of the home or building may be heated automatically to the desired temperature.

2) *Economy* – heating plant need no longer burn fuel to furnish unwanted heat.

ZONE CONTROL VALVES are the most *economical* devices for accomplishing zone heating control. With them, multiple zones may be individually controlled from a single burner and circulator.

Each zone is controlled by its own thermostat. All wiring is inexpensive low-voltage.

ZONVALVES mean:
more profits, better jobs!

ZONVALVE is a zone-control valve of *outstanding quality*, as well as extremely low price.

Zonvalve is thermostatically operated. All Zonvalves contain a built-in auxiliary switch, which *automatically* starts circulator or burner, when any Valve is in "open" position.

Zonvalve may be installed in any position on supply piping or individual radiator. In modernization, Zonvalve replaces the ordinary radiator valve with *no piping change*, no shutdown of heating system.

Zonvalve is compact, rugged in construction. It is manufactured in standard tubing and pipe sizes. Operates on steam and hot water systems. *Unconditionally guaranteed.*

Zonvalve is ideal for zoned heat in homes, offices, factories, hospitals, hotels and motels.

For fast sales, *sell Zonvalve!*

For full details, ask your wholesaler or write for Brochure D-10.

HEAT-TIMER CORP. · 657 BROADWAY, NEW YORK 12, N.Y.

FEED WATER SYSTEMS—A specification sheet for boiler feed water systems is published by Cyclotherm Div., National-U. S. Radiator Corp., Oswego, N. Y. Containing several charts on pump discharge, boiler pressure and receiver capacity, data sheet also gives specific information on the company's Simplex and Duplex feed water systems.

Circle **Item 93** on Inquiry Card

AIR CONDITIONING EQUIPMENT — The 36-page 1958 estimating catalog of M. Blazer & Son, Passaic, N. J., covers over 80% of the equipment and supplies normally used by contractors and engineers in heating, ventilating, refrigeration, and air conditioning. Quick selection and pricing of equipment is made possible with specially prepared tables.

Circle **Item 94** on Inquiry Card

LIGHT HORSEPOWER COUPLINGS — John Waldron Corp., New Brunswick, N. J., a subsidiary of the Midland-Ross Corp., announces Bulletin 61 describing the company's Flexring coupling. Bulletin includes diagrams and tables on the coupling which comes in four sizes for light horsepower applications up to 1000 rpm.

Circle **Item 95** on Inquiry Card

EXHAUST AND SUPPLY VENTILATOR— Four-page Bulletin 344, published by Canada Fans Limited, Montreal, Que., describes construction and operation of the company's Dual-Aire ventilator which is capable of simultaneously supplying and exhausting air. Selection table with performance data is comprehensive.

Circle **Item 96** on Inquiry Card

IMMERSION STEAM BOILERS — Four-page folder from Sellers Engineering Co., Chicago, Ill., describes the company's Model 105 immersion steam boilers in sizes from 105 to 400 hp. Benefits of immersion firing in gas-fired boilers are also given in Bulletin No. 5209.

Circle **Item 97** on Inquiry Card

REGISTERS, GRILLES, DIFFUSERS — Complete selection data on the Air Master line of registers, grilles, and diffusers are offered by the manufacturer, Austin Engineering & Mfg. Co., Inc., Ysleta, Tex. Included are recommended outlet velocities for safe sound limits in various applications.

Circle **Item 98** on Inquiry Card

(Concluded on page 140)

Use the prepaid postcard on last page for securing your copies of catalogs described in this department.

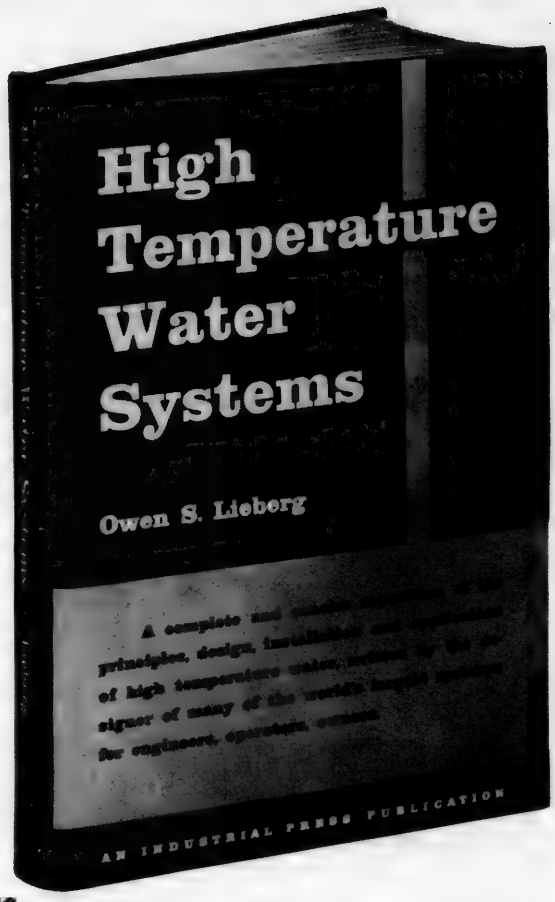
NEW • COMPLETE AUTHORITATIVE

HIGH TEMPERATURE WATER SYSTEMS meets the need for an authoritative explanation of the principles, design and operation of high temperature water (HTW) systems.

The author is a distinguished international authority who served as consultant on the largest HTW system in England (Bicester Ordnance Depot) and such U.S. installations as the Forbes and Olmstead Air Force Bases and the Cross factory in Detroit. He also designed the HTW system for the largest military establishment in Canada.

The book contains original design data used successfully in actual systems. Tables, graphs, photographs and specifications serve as a working guide . . . and let you benefit from Mr. Lieberg's knowledge and experience.

A special feature is a full-chapter treatment of the design of a typical system . . . step by step . . . based on the principles developed in the book. After mastering this procedure, the engineer will have little difficulty in completing the design of *any* HTW system!



CONTENTS

1. **Advantages of High Temperature Water**
   Arguments for HTW. Brief history. Sample calculation comparing HTW to steam.
2. **Thermal Properties of Water**
   Basic thermodynamics. Units defined. Property tables for water and steam.
3. **Some Design Considerations**
   Temperature drop, system pressure, thermal storage, system flexibility, secondary steam.
4. **Pressurizing the System**
   Reviews pressurizing methods: Steam, air, inert gas. Special cases; heat-power systems.
5. **Boilers and Expansion Tanks**
   Boiler selection. Water tube boilers. Summer load conditions. Sizing expansion tanks. Nitrogen pressure tanks.
6. **Controlling the System**
   Combustion control for various fuels. Control panels. Water level and flow control. Btu meters.
7. **System Circulation Pumps**
   Great detail covering the "heart of the system." Guarding against flashing. Pump specs. Friction heads. Parallel pumps. Auxiliaries, drives, piping.
8. **Valves**
   Valve types and selection. Materials. Emergency closing valves. Valve sizing. Venting by air bottles.
9. **Piping**
   Heat flow capacity of pipes. Design temperature drop. Expansion loops and joints. Pipe sizing and insulation.
10. **Process Heating**
    HTW for process heating. Heat exchangers and converters. Valving and control for process.
11. **Space Heating with HTW**
    Unit heaters. Fan-coil systems. Radiant panels. Complete with application data for all systems.
12. **Applications**
    Describes numerous military and civilian installations in U. S., Canada, and Europe. Economic and design comparison with low temperature water and steam systems for similar situations.
13. **Designing a Typical System**
    Ten-step design procedure for any HTW system. Theory and practice summarized and applied to complete design example.
14. **Appendix**
    A complete specification of a typical boiler plant and auxiliaries for a high temperature water system.

THE INDUSTRIAL PRESS, 93 Worth Street, New York 13, N. Y.

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☐ Check or money order is enclosed. Send book(s) postpaid.

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109 illustrations

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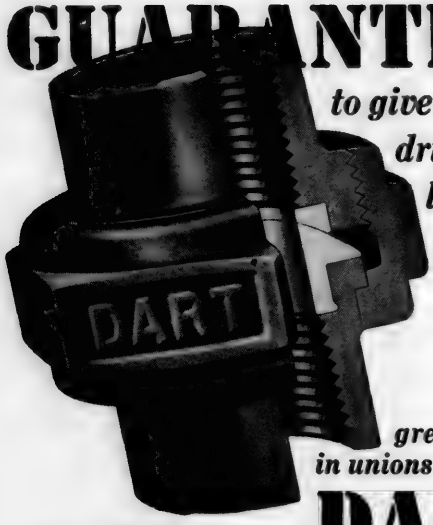

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For over 55 years the firm guarantee back of each and every DART UNION sold has been — *"if one should leak through we will give you two"!* The record reveals that less than 1 in every 100,000 has proven to be faulty. The extra wide bronze to bronze seats, precision ground to a true ball joint, mounted in heavy malleable iron pipe ends and protected by an extra heavy union nut, make a drip-tight, leak-proof connection WITHOUT EXCESSIVE WRENCHING time and time again.

Guarantee positive tight connections and extra long service on your pipe lines by using the DART GUARANTEED UNION.

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Write for Bulletin 131

NIAGARA BLOWER COMPANY

Dept. HV-11, 405 Lexington Ave., New York 17, N.Y.

Niagara District Engineers in Principal Cities of U. S. and Canada

NEW CATALOGS

(Concluded from page 138)

Use the prepaid postcard on last page for securing your copies of catalogs described in this department.

BLOWER WHEEL HOUSINGS — Two bulletins are offered by Revcor, Inc., Carpentersville, Ill. One, No. H-58, describes, and gives specifications for, sheet metal housings for use with the company's blower wheels. The other, No. I-58, gives dimensions of a complete line of inlet rings.

Circle **Item 99** on Inquiry Card

PIPE SUSPENSION AND SUPPORT — Entitled For the Life Streams of Your Building, a 24-page bulletin published by Fee & Mason Mfg. Co., Inc., Manasquan, N. J., considers the why, when, where, and how of pipe suspension and support. It describes various types of hangers, supports, and accessories, and includes tables for their proper application.

Circle **Item 100** on Inquiry Card

CLEANING COMPOUNDS, SOLVENTS— Industrial cleaning compounds and solvents are the subject of an 8-page bulletin offered by Brulin & Co., Inc., Indianapolis, Ind. Products described include liquid steam cleaners, rust and scale solvent, aluminum surface brightener, and all-purpose degreaser. Applications are illustrated.

Circle **Item 101** on Inquiry Card

DIAPHRAGM TEMPERATURE SENSORS A bulletin describing the advantages of diaphragm temperature sensors for use in home and commercial appliances is available from Bridgeport Thermostat Div., Robertshaw-Fulton Controls Co., Milford, Conn. The manufacturer offers the thermal sensing units preassembled and ready for mounting.

Circle **Item 102** on Inquiry Card

WELDING ALUMINUM — Instructional information designed to train and qualify individuals in welding aluminum by the inert gas process is presented in 144-page Weldor's Training Manual. Copy of the booklet may be obtained free when requested upon company letterhead. A charge of one-dollar per copy is made when the booklet is requested for personal reference use. Address all requests to Technical Publications Dept., Kaiser Aluminum & Chemical Sales, Inc., 919 N. Michigan Ave., Chicago 11, Ill.

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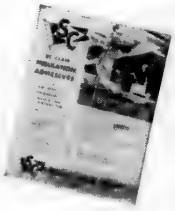

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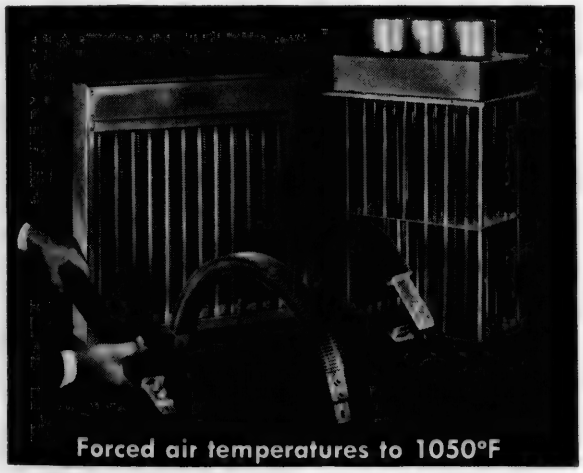

CHROMALOX *Electric* **Air Duct Heaters**

For space heating or for adapting present air conditioning systems for central heating, here is the efficient, economical answer.

Heaters can be installed quickly and easily in round or rectangular ducts and controlled either manually or by automatic thermostat.

115, 208, 230, 460 volts. 91 *standard stock* types, sizes and ratings ready for immediate delivery.

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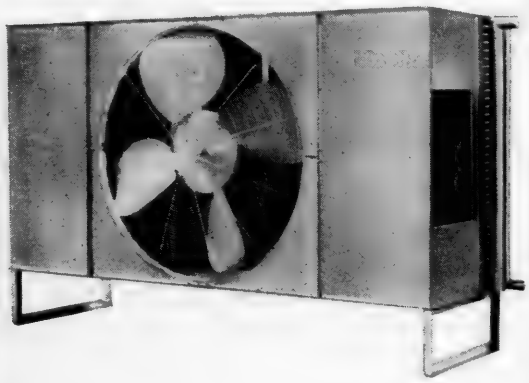

STANDARD SELF-CONTAINED, REMOTE MODELS, 3 TO 25 TONS. RANGE UNLIMITED BY DUPLEXING. INDOOR-OUTDOOR REFRIGERATION OR AIR CONDITIONING JOBS! "DRAW-THRU" PRINCIPLE. TOTALLY ENCLOSED MOTORS. FANS, NAFM-RATED. FAN GUARDS HEAVY WIRE, 'N PLATED. ANGLE-IRON MOUNTING STAND. FEATURES GALORE, ASK US MORE.

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DIVISION OF NATIONAL-U S RADIATOR CORP

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CABLE: CLICONI LOS ANGELES

• **NEW FIELDS**—The heaters find a place in many industrial and commercial drying operations, medium temperature processing work, and agricultural applications, GAMA states. A field seen certain to become more important involves maintaining various temperature zones in different sections of the same warehouse. Separate needs may exist for food preservation, prevention of condensate damage and other requirements. In some instances the heaters are used to eliminate cold weather stoppage on construction projects. In a Columbus, Ohio, industrial building ten large heaters were so used, providing the temperatures necessary for construction personnel and for such tasks as plastering and painting. The heaters subsequently became part of the permanent heating installation.

BUILDING NOISE CONTROL

is subject of conference scheduled for January, with discussion in terms readily understood in industry.

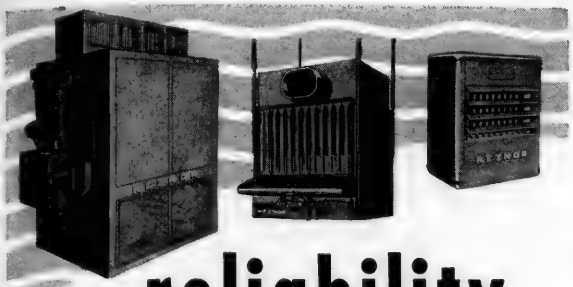
"Noise Control in Buildings", described as a research correlation conference, is scheduled for January 14-15 at the New Yorker Hotel, New York City. Conducted by Building Research Institute, the conference will examine the various facets of the subject in language keyed to the needs of architects, builders, engineers, and contractors.

Lighter weight construction, new types of interior partitions, and increased use of mechanical equipment in buildings all have given rise to a widespread call by builders and architects for more information about noise control in terms they can understand, according to Charles H. Topping, president of BRI. Prominent in the group of nationally known experts who will tackle the problem will be Robert B. Newman of Bolt, Beranek and Newman, Inc., one of the country's leading acoustical consulting firms, who will give a physical demonstration of noise control fundamentals to open the two-day meeting.

Under the chairmanship of John S. Parkinson, manager of building products research for Johns-Manville Corporation, a BRI committee has laid out a program which will deal with the comparatively new noise problems encountered in buildings of all kinds due to increased use of lighter weight construction in exterior walls, floors and interior partitions, and to the use of such mechanical equipment as high velocity air conditioning and ventilation systems, high frequency lighting equipment, air duct terminal devices, communication systems, business machines, etc., in all types of buildings.

Building Research Institute is a unit of the Division of Engineering and Industrial Research of the National Academy of Sciences-National Research Council, Washington, D. C. It conducts an average of three to four such research correlation conferences annually. Additional information about this conference, complete program and registration forms may be had by writing Harold Horowitz, BRI Technical Secretary, 2101 Constitution Ave., Washington 25, D. C.

(News of the Month concluded on page 144)



reliability

Reznor heaters are designed and built for long life and reliable service. They've proved their ability to do the job in countless thousands of commercial and industrial installations. Quality always pays off in the long run. When you specify Reznor equipment you can be confident that you're specifying a quality heating system which will give your client years of trouble-free service with minimum maintenance.

RELIABILITY is just one of many reasons why there is no "equivalent" for Reznor . . . the world's largest-selling gas unit heater. Ask your Reznor distributor for the complete story or write for your free copy of "Modern Heating".

Look for Reznor under Heaters-Unit" in the Yellow Pages

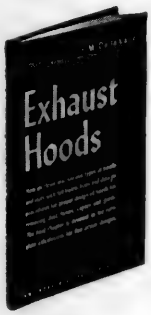
REZNOR

WORLD'S LARGEST-SELLING DIRECT-FIRED

UNIT HEATERS

Reznor Manufacturing Company, 64 Union Street, Mercer, Pa.

EXHAUST HOODS



The only book published that gives comprehensive information on the flow of air around and into the openings, hoods or slots in exhaust ventilating systems. Covers all phases of hood, booth and slot design. Shows how to determine the required air volume and velocity for hoods and other types of openings for the control of all kinds of dusts, fumes and gases. Sample problems, with the solutions worked out in detail, are given in a chapter devoted entirely to this matter.

141 Pages, 127 Illustrations, 30 Tables, $4.00

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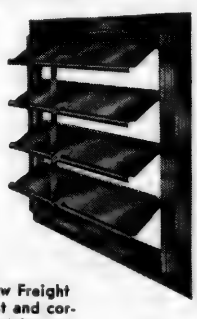
Elgo Ventilating Specialties



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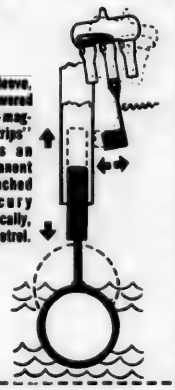
■ Of all boiler water level controls, we believe Magnetrol to be the safest. Certainly it is the simplest.

A PERMANENT Alnico magnet, located *outside* the float chamber, links boiler water level and electrical controls. This infallible magnetic link eliminates mechanical parts normally subject to wear and fatigue failure. *Pioneered and perfected by Magnetrol,* it provides almost unlimited operating life.

The brass "No-Scale" float chamber liner, another exclusive Magnetrol feature, is self-cleaning. It actually "flexes" off scale and prevents "sticking" of the float.

These are just two of *many* advances for greater boiler safety found *only* in Magnetrol. *Standard* Magnetrol units are available for temperatures up to 750°F., at pressures up to 600 psi, for single stage (low water cutoff) or multi-level stage (pump control *plus* low water cutoff and alarm) service with as many as three separate switching actions. Special units are available for more extreme requirements.



A magnetic sleeve, raised and lowered within a non-magnetic tube, "trips" or releases an Alnico permanent magnet attached to a mercury switch. Basically, this is Magnetrol.

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Once upon a time ...

there was a porcupine who often appeared somewhat needled. He had been buying outmoded disposable media filters that were expensive to use and very difficult to install.

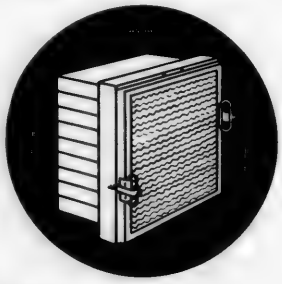
At first he felt it would be pointless to try the new, preformed Far-Air HP Filter which had become so popular, because of it's efficiency, economy, and convenience.

Then one day his friendly Far-Air man slipped a folded HP Filter right under his door. Mr. Porcupine got the point when he popped it open and realized how easy it would be to install. He specified HP filters because they solved his problem.

Now he's really sharp . . . he's sticking with them.

Moral:

Compare before you specify. See the new Far-Air HP Filter. Take quill in hand and fill out the coupon below.



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ASSE ANNUAL MEETING

re-elects White president. Membership is at all-time high. Opening followed two-day refresher course.

The 52nd Annual Meeting of the American Society of Sanitary Engineering which took place in Atlantic City, N. J., September 21-25, re-elected W. Wilbur White, Detroit, Mich., president, and Mike Mercury, Chicago, Ill., treasurer. The delegates heard that the Society had reached an all-time high for membership with a total of 2251.

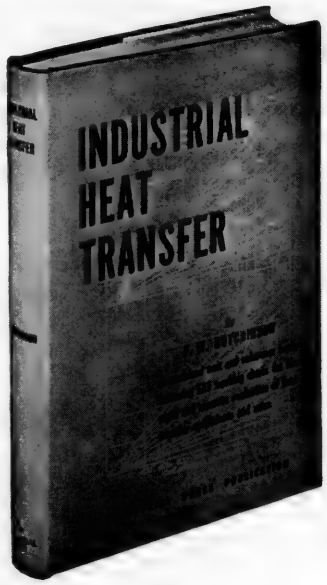
The first two days were spent in sessions of the 13th Refresher Course, when dozens of speakers presented short talks on many aspects of plumbing design. During the Annual Meeting proper, the following papers were presented by Arthur I. Heim, chairman of the Research Committee: *Radioactive Waste Disposal Problems and Data*, by Louis W. Gellert; *Capacity of Three House Drains*, by Robert Wood; *Comments on Capacity of Plumbing Drainage*, by Robert Wyly; *Actual Trends in Sanitary Engineering and Water Supply in Europe*, by Prof. W. F. J. M. Krul, The Hague, Netherlands; and *Lead Poisoning, A Sanitary Engineering Problem*, by Henry Pleasants, Jr., M.D.

Nine vice-presidents were elected. They are: Arthur Whitney, St. Louis, Mo.; Edward Zimmer, Chicago, Ill.; J. Frank Warren, Ft. Lauderdale, Fla.; Harry E. Goss, San Francisco, Calif.; James L. Foster, Indianapolis, Ind.; James C. Church, New York, N. Y.; James Shelton, Little Rock, Ark.; Keith Clotz, Rocky River, Ohio; and Norbert Melnick, Arlington, Va. Members of the Board of Directors are: William Watt, Vancouver, B. C.; Homer S. Yetman, Hartsdale, N. Y.; James V. Crosta, Newark, N. J.; Lawrence Dean, St. Louis, Mo.; and William Reichert, Chicago, Ill.

Canadian Degree-Days for September, 1958*

City	September		Cumulative	
	1958	Normal	1958	Normal
Calgary, Alta.	422	410	422	410
Charlottetown, P. E. I.	284	240	284	240
Crescent Valley, B. C.	363	330	363	330
Edmonton, Alta.	438	440	438	440
Fort William, Ont.	337	370	337	370
Grande Prairie, Alta.	508	450	508	450
Halifax, N. S.	195	190	195	190
London, Ont.	174	150	174	150
Medicine Hat, Alta.	298	300	298	300
Moncton, N. B.	306	260	306	260
Montreal, P. Q.	177	190	177	190
North Bay, Ont.	309	320	309	320
Ottawa, Ont.	221	200	221	200
Penticton, B. C.	221	200	221	200
Prince George, B. C.	512	460	512	460
Quebec City, P. Q.	295	290	295	290
Regina, Sask.	347	370	347	370
St. John, N. B.	317	360	317	360
Saskatoon, Sask.	382	380	382	380
Timmins, Ont.	382	410	382	410
Toronto, Ont.	130	154	130	154
Vancouver, B. C.	202	220	202	220
Victoria, B. C.	253	230	253	230
Windsor, Ont.	129	120	129	120
Winnipeg, Man.	306	311	306	311

* These data are supplied through the courtesy of the Meteorological Division, Air Service Branch, Department of Transport, Canada.



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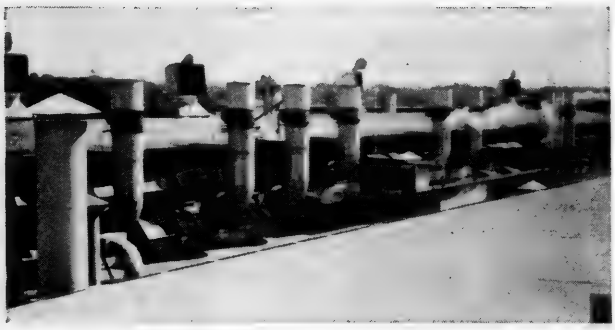
and upturn at KVP



Same picture – different setting. Top shows complicated, space-wasting duct system which routed fumes back into plant for discharge through stacks. Bottom shows nine new 36" Aerovent "SP-7" Duct Fans installed to take fumes *up* and *out*, saving valuable floor space in busy working area. Just one of hundreds of successful Aerovent installations characterizing modern air engineering in action.

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BOOK REVIEWS

Publications abstracted in this department should be ordered direct from publisher.

OIL BURNERS

An unusual book under the title Domestic Oil Burners and Oil Heat—Installation and Service, has appeared under the authorship of Lee Auslander, combustion engineer and chief instructor in heating, Philadelphia Wireless Technical Institute.

The book is unusual in that it employs a patented feature by which the illustrations and tables are in one portion of the book, text in another, so arranged that an illustration or table and related text can be followed simultaneously, without turning pages.

The book was written to satisfy the need for practical, down-to-earth approach to the subject of oil burners and their application. Most of the material has been assembled during the author's twenty-two years as heating mechanic, service manager, engineer and classroom instructor. Every chapter is written in simple, non-theoretical style, and is said to have been tested under shop conditions for eight years.

In addition to the chapters on the function of the burner and its allied equipment, the book includes considerable information on heating systems of various types, and valuable material on heat surveys.

Domestic Oil Burners and Oil Heat, by Lee Auslander. 6 x 9 inches, 245 pages of text, 155 pages of tables and illustrations. Paper covers, spirally bound to lie flat. Published by Rinehart & Co., Inc., 232 Madison Ave., New York, N. Y. Price, $6.95.

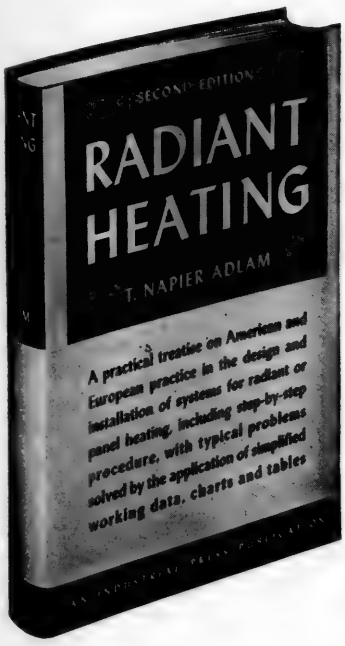
• • •

STANDARDS FOR DRINKING WATER COOLERS—The ARI has issued Standard 1010-58 to establish methods of rating mechanically refrigerated drinking water coolers and also to specify minimum requirements for sanitation, safety and performance for such self-contained units. Air-Conditioning and Refrigeration Institute, 1346 Connecticut Ave., N.W., Washington 6, D. C. Price, 50 cents.

WELDING HANDBOOK—American Welding Society announces publication of Section II of the Fourth Edition of the Welding Handbook. Section II, of the five-section edition which is published on a revised section per year basis, contains thirteen chapters, each with its own table of contents. Scope includes gas, arc, and resistance welding processes. Section II may be obtained from American Welding Society, 33 West 39th St., New York 18, N. Y. Price, $9.

ARI STANDARD 410 REVISED—ARI Standard 410 on Forced Circulation Air Cooling Units has been revised and all of ARI Standard 411 has been deleted. The new standard is numbered ARI 410-58, and covers the methods of testing and rating formerly prescribed by Standard 411. Available from Air-Conditioning and Refrigeration Institute, 1346 Connecticut Ave., N.W., Washington 6, D. C.

Here is a Book That Gives You All the Answers!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PRINTED FORMS available for immediate shipment. Heating & oil burner materials form, burner service record cards, service order forms, inspection information form, survey sheet and others. Also can supply BURNER SERVICE form in 8 part EZE-SNAP with 2 carbons in each set, 1200 sets IMPRINTED with your name, address and telephone, only $20.40. Send for samples—no obligation. Write Dept. AC, Degree Day Systems, 39-30 58th St., Woodside 77, N. Y.

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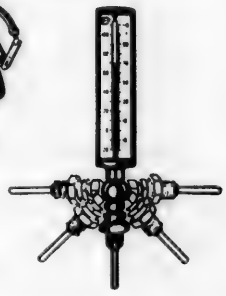

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COMING EVENTS

Where listed, names or titles of individuals are those from whom further information is available

TECHNICAL WRITERS CONVENTION—Sixth annual convention of the Society of Technical Writers and Editors, Inc., at the Shoreham Hotel, Washington, D. C. G. J. Goodstadt, public relations director of the Society, 11 Riverside Drive, New York 23, N. Y. . . . . **NOVEMBER 17-18, 1958.**

PLASTICS INDUSTRY EXPOSITION—Eighth national plastics exposition of the Society of the Plastics Industry, Inc., at International Amphitheatre, Chicago, Ill., to be held concurrently with the SPI annual national conference, Morrison Hotel, Chicago. Secretary of the Society, 250 Park Ave., New York 17, N. Y. . . . . **NOVEMBER 17-21, 1958.**

AIR POLLUTION CONFERENCE—The National Conference on Air Pollution, at Sheraton-Park Hotel, Washington, D. C. Surgeon General, Public Health Service, Department of Health, Education, and Welfare, Washington 25, D. C. . . . . **NOVEMBER 18-20, 1958.**

POWER SHOW—23rd National Exposition of Power and Mechanical Engineering, under the auspices of The American Society of Mechanical Engineers, in conjunction with the Society's 78th annual meeting, at the Coliseum, New York. E. K. Stevens, president, International Exposition Co., 480 Lexington Ave., New York 17, N. Y. . . . . **DECEMBER 1-5, 1958.**

CONSTRUCTION INDUSTRY CONFERENCE—Fourth National Construction Conference, sponsored by Armour Research Foundation of Illinois Institute of Technology, the American Institute of Architects, American Society of Civil Engineers, Associated General Contractors of America, and the Building Research Institute, at Hotel Sherman, Chicago, Ill. M. J. Jans, conference secretary, Armour Research Foundation, 10 W. 35th St., Chicago 16, Ill. . . . . **DECEMBER 10-11, 1958.**

TRI-SECTION MEETING—Combined Metropolitan New York, New Jersey and Philadelphia sections, American Industrial Hygiene Association, John Bartram Hotel, Philadelphia, Pa. Afternoon session and dinner meeting. Secretary, Jesse Lieberman, Department of Public Health, Room 630 City Hall Annex, Philadelphia 7, Pa. . . . . **DECEMBER 12, 1958.**

EXPOSITION AND ASHAE CONVENTION—65th annual meeting, American Society of Heating and Air-Conditioning Engineers (Jan. 26-29, 1959) and 14th International Heating and Air Conditioning Exposition, Philadelphia, Pa. A. V. Hutchinson, secretary of the Society, 62 Worth St., New York 13, N. Y. . . . **JANUARY 26-30, 1959.**

HOME PRODUCTS SHOW—Home Improvement Products Show (HIPS), to be held at the Coliseum, New York, N. Y. Ted Black Agency, Medical Arts Bldg., Reading, Pa. . . **FEBRUARY 4-6, 1959.**

INDUSTRIAL VENTILATION CONFERENCE—8th annual conference on Industrial and Mining Ventilation, sponsored by the Division of Occupational Health, Michigan Department of Health; and the Department of Mechanical Engineering and Continuing Education Service of Michigan State University, to be held at Kellogg Center for Continuing Education, Michigan State University, East Lansing, Mich. Write to the University for details. **FEBRUARY 16-19, 1959.**

WESTERN METAL EXPOSITION—Eleventh Western Metal Exposition and Congress, of the American Society for Metals, at the Pan-Pacific Auditorium and Ambassador Hotel, Los Angeles, Calif. R. Y. Bayless, assistant secretary of the Society, 7301 Euclid Ave. Cleveland 3, Ohio. . . . . **MARCH 16-20, 1959.**

GAMA MEETING—Annual meeting of the Gas Appliance Manufacturers Association, at the Americana Hotel, Bal Harbour, Fla. H. Leigh Whitelaw, managing director of the Association, 60 E. 42nd St., New York, N. Y. . . . . **APRIL 1-3, 1959.**

ASRE CONVENTION—Convention of the American Society of Refrigerating Engineers, at the Hotel Traymore, Atlantic City, N. J. R. C. Cross, secretary of the Society, 234 Fifth Ave., New York 1, N. Y. . . . . **OCTOBER 30-NOVEMBER 1, 1959.**

ARI EXPOSITION—11th Exposition of the Air-Conditioning and Refrigeration Industry at Convention Hall, Atlantic City, N. J. Geo. S. Jones, Jr., managing director of Air-Conditioning and Refrigeration Institute, 1346 Connecticut Ave., N. W., Washington 6, D. C. . . . . **NOVEMBER 2-5, 1959.**

ASHAE MEETING—66th annual meeting of the American Society of Heating and Air-Conditioning Engineers, and the 2nd Southwest Heating and Air-Conditioning Exposition, sponsored by ASHAE, in Dallas, Tex. The meeting will be at the Baker and Adolphus Hotels and the Exposition in the Memorial Auditorium. Secretary of the Society, 62 Worth St., New York 13, N. Y. . . **FEBRUARY 1-4, 1960.**

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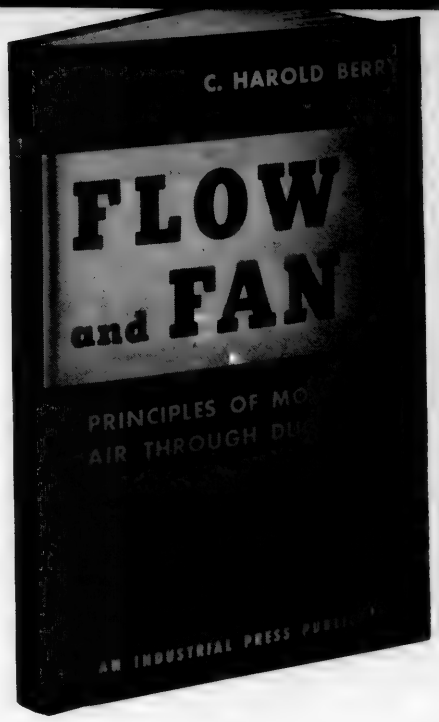

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* Advertiser appeared in previous issue

THE MOST ADVANCED DESIGN..... in ASME-rated pressure relief protection for hot water boilers is found in the double-safe design of this manufacturer's valves. Bulletin is offered.
Inside Front Cover — Item 200

STEAM HUMIDIFIERS..... give large humidifying capacity at low cost by discharging clean, dry steam directly into room atmosphere or into air stream in ducts or plenums. Control is by accurate humidistats. Sixteen-page bulletin is available.
Page 1 — Item 201

COPPER TUBE FITTINGS..... are available in a carton which serves as a handy container on job, in truck, or in stock room. Contents are clearly indicated. Catalog is offered.
Page 2 — Item 202

ANOTHER FUTURE..... of faultless service is assured for Seton High School of Cincinnati, Ohio, through use of the manufacturer's flush valves. Information is available.
Page 5 — Item 203

IT TAKES ONLY ONE..... to install pipe, but five to replace it; that's why corrosion costs more than the new wrought iron pipe available from this manufacturer. Information is available.
Page 9 — Item 204

CONSULTING ENGINEERS..... put low maintenance cost high on the list of things to look for in ventilating equipment. These fans, motors and ventilators cost little to maintain. Literature is available.
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UNIVERSAL PUMPS..... satisfy every conceivable circulation requirement of systems using water for heating and cooling. Engineering data are offered.
Page 17 — Item 206

LOW VELOCITY AIR DIFFUSERS..... were specified for the West's largest office building, the Kaiser Center at Oakland, Calif. Information is available.
Page 18 — Item 207

CONDENSATE PUMPS..... from this manufacturer eliminate the need for a custom job. A standard pump is available to meet all exacting requirements. Bulletins available.
Page 19 — Item 208

INDUSTRIAL AIR FILTERS..... explode the fiction that it costs less to buy replaceable filters and throw them away when dirty than to have permanent filters cleaned. Information is available.
Page 20 — Item 209

DUCT INSULATION..... is made exclusively of long, strong, textile-type glass fibers. It is outstanding in thermal efficiency and ease of application. Information is offered.
Page 21 — Item 210

NEW YORK'S COLISEUM..... uses this company's trouble-free motor control for fan room control panel, chilled water and condenser pumps. Information is available.
Page 22 — Item 211

CONDENSING UNIT..... from this manufacturer is an achievement in compact efficiency, featuring inter-changeable vital parts. Information is available.
Page 23 — Item 212

CONTROL CENTERS..... set the pace in comfort, simplify air conditioning operations at Guarantee Mutual Life Co.'s new home office in Omaha, Nebr. Information is available.
Page 24 — Item 213

A NEW CORPORATE FACE..... is presented to the industry by this manufacturer of air conditioning and refrigeration products. Information on these products is available.
Page 25 — Item 214

BIG AIR CONDITIONING JOBS..... require compressors from a big line such as that offered by this manufacturer. Long life, reliable operation, are compressor features. Information is available.
Page 26 — Item 215

EVEN THE BEARINGS..... are built for comfort in Westinghouse Comfort Command air conditioners. Bearings on blower shaft feature balls and races especially polished for noiseless service. Bulletin is offered.
Page 27 — Item 216

Below and on the following pages are given brief digests of the advertisements appearing in this month's issue. Use this Digest to locate and refer to the advertisements in which you are particularly interested, then fill out and mail the prepaid postcard to request further information from manufacturers.

The items appear in the same order as the advertisements to which they refer, to facilitate obtaining further information after reading an advertisement.

NOTE: All advertisements are digested here except those received too late for inclusion. The index of Advertisers lists all the advertisements in this issue.

Use the postcard below for catalogs, new equipment and materials, as well as Ad-Digest items.

Circle numbers corresponding to the items and advertisements in which you are interested, print your name and address clearly. Information will be sent directly from manufacturers.

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PLANNING A SCHOOL..... that will still be functional in the year 2000 was the challenge faced by planners of Schenectady's Linton High School. Proper thermal environment was served by this manufacturer's temperature control system. Information is available.
Pages 28-29 Item 217

AIR CONDITIONING PUMPS..... from this manufacturer are engineered with one idea: To make equipment designers' jobs easier. Information is available.
Page 30 Item 218

HEATING AND VENTILATING..... units are flexible for any job, versatile for any need. Often one unit will do what normally requires two or more other units. Information is available.
Page 31 Item 219

ELECTRIC HUMIDIFIERS..... are designed to provide capacity for practically any size requirements, automatically introducing water vapor, removing up to 70% of all bacteria in the air stream. Information is available.
Page 32 Item 220

PERFORATED AIR OUTLETS..... provide uniform ceiling design, have unlimited patterns and built-in air controllers, and offer draftless air distribution. Catalog is available.
Page 35 Item 221

14th INTERNATIONAL..... Heating and Air Conditioning Exposition will be held in Convention Hall, Philadelphia, Pa., January 26-29, 1959, under the auspices of ASHAE. Exposition company suggests you write for advance registration.
Pages 36-37 Item 222

FIBER GLASS INSULATION..... is great for insulating against heat, cold or noise. Three tests prove its strength. Information is available.
Page 38 Item 223

HEATING EQUIPMENT FILE..... composed of four catalogs provides installation and performance data that you will need when specifying any hot water system. File is available.
Page 39 Item 224

"TAILOR-MADE" H&V SYSTEMS..... are made with standard units. Sectional construction of basic components provides required capacity at savings in time, money, and space. Bulletin available.
Pages 40-41 Item 225

SUBMERSIBLE SUMP PUMP..... is built for automatic submerged operation. Designed to operate under water, this packaged unit is priced lower than many conventional sump pumps. Information is available.
Page 42 Item 226

INDUSTRIAL AIR TRAVEL..... is accomplished dependably with air handling and conditioning equipment manufactured by this company. Information is available.
Page 43 Item 227

GAS AIR CONDITIONING..... keeps customers cool and operating costs down at the Motel Washingtonian near Washington, D. C. Information on cooling with gas is available.
Pages 44-45 Item 228

MODEL OF EFFICIENT OPERATION... is the new home of the Boston Globe which uses this manufacturer's valves in the control of water, air, gas, heating and air conditioning lines. Information is available.
Page 46 Item 229

NEW ANSWER..... to old heating problems is contained in the manufacturer's system of accurate, economical and practical room by room temperature control. Information is available.
Page 47 Item 230

NEW MODELS, NEW SIZES..... and new styling are features of these self-contained air conditioning units. Air or water cooled, they are easier to install and service. Information is available.
Pages 48-49 Item 231

SEAMLESS STEEL PIPE..... was used in the installation of a new air conditioning system for one of Chicago's landmarks, the towering Field Building on South LaSalle St. Information is available.
Page 50 Item 232

AMCA-RATED AIR MOVERS..... are built by charter member of AMCA and produced to AMCA standards. Backward curve blower and centrifugal roof ventilator are two in its expanded line. Bulletins available.
Page 52 Item 233

COMMERCIAL GAS BOILER..... offers the extra values you have been looking for. It is designed to burn fuel efficiently and to absorb a maximum amount of heat. Engineering data is offered.
Page 54 Item 234

QUIET AXIAL FLOW FANS..... have inherent efficiency further improved by vaneaxial outlet guide vanes which redirect air for increased forward thrust. Duct-size units save space. Bulletin is available.
Page 55 Item 235

DUCT INSULATION..... provides notable insulation value per dollar. Eight carloads were used in the largest air conditioning insulation job in the history of the West Coast. Information is available.
Page 56 Item 236

IMPROVED CONTROLS..... for all types of unit ventilators are offered. Combined thermostat-and-motor operator mounts directly on unit for greater control accuracy, lower installation cost. Application file is available.
Page 111 Item 237

AIR CONDITIONING UNITS..... that are factory assembled by this manufacturer prove more economical than field-assembled systems. Florida hotel saved $50,000 annually by using zone-by-zone units instead of field-assembled central station system. Information is available.
Page 113 Item 238

TO ERR IS HUMAN..... and that is why this company claims that its flanges are "almost" human. Perfection is guaranteed. Information is available.
Page 115 Item 239

WASHFOUNTAINS AND SHOWERS.... from this manufacturer provide the most sanitary, convenient, and economical facilities available to those doing school work. Catalog is available.
Page 116 Item 240

A LOUVER RAIL COIL..... offered by this company is an economical and practical method for fabricating louvers. Removable, hinged, or stationary. Hundreds of variations possible. Information is available.
Page 116 Item

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ACTIVATED CHARCOAL..... air filter, combined with the company's electronic air cleaner, provides air with the highest level of purity and cleanliness possible. Information is available.
Page 119 Item 242

NEW MATERIALS, NEW DESIGNS.... in the company's pneumatic valve and motor increase performance for control of steam or water. Information is available.
Page 120 Item 243

PNEUMATIC ROUND THERMOSTAT.. is available in models for every application—summer-winter, day-night, modulating, two-position, and submaster. Information is offered.
Page 121 Item 244

SHOWER MIXING VALVE..... is thermostatically controlled for the safest, most comfortable showering. There are no protruding edges to injure, no chance of accidental scalding. Information is available.
Page 122 Item 245

DUST COLLECTOR..... is an in-duct "educated pipe" that saves space, saves weight and saves water in its efficient collection of dust. Bulletin is available.
Page 129 Item 247

FLEXIBLE HOSE..... is adaptable for all kinds of fume and dust control and ventilation uses. It is durable, lightweight, and easy to install. Information is available.
Page 130 Item 248

COOL THINKING, COOL FUN..... are offered in Marquette University's air conditioned Brooks Memorial Union through use of this manufacturer's equipment. Literature is available.
Page 131 Item 249

MAXIMUM PERFORMANCE..... and efficiency are provided by pumps from this manufacturer. Pump engineers offer technical assistance on applications of the complete line. Details are available.
Page 132 Item 250

PORTABLE PYROMETER..... in a wide selection of thermocouples and extension arms assures adaptation to your needs. Eight scaled ranges are available up to 2000 deg F. Bulletin is available.
Page 133 Item 251

REFRIGERATION EQUIPMENT..... from this manufacturer is world renowned for a long trouble-free life of dependable operation in any refrigeration service. Information is available.
Item 252

HEAVY DUTY BOILERS..... for every steam or water heating application up to 1.8 million Btu per hr. output are found in this manufacturer's line. Information is available.
Page 134 Item 253

NEW SUPPLY PUMP EQUIPMENT..... to handle No. 5 and 6 furnace oils is available in either direct or belt drive with motors from ¼ to 2 hp, with pumps delivering from 28 to 575 gph, pressures to 300 psi. Compact, easy to install, units' specifications and mounting dimensions contained in catalog offered.
Page 135 Item 254

RADIANT-ACOUSTICAL CEILINGS..... provide complete integration for economy, comfort, and efficiency. Never caused condensation! Folder describes them.
Page 136 Item 255

IMPULSE STEAM TRAP..... and a fine screen strainer, both manufactured by the company, are a good team for steam. Steam trap book is available.
Page 136 Item 256

ICE ACCUMULATORS..... are designed to deliver 12 to 24-deg F water for circulation through air cooling coils in air conditioning systems. The banks may be added to existing systems for increased capacity. Information is available.
Page 137 Item 257

NO FILTER..... does all jobs or meets every need. That's why the company's filters are engineered to the job to offer more effective dust collection. Bulletins are available.
Page 137 Item 258

ZONE-CONTROL VALVE..... ensures comfort in each area of the home or building but eliminates burning of fuel to furnish unwanted heat. Contains built-in auxiliary switch which automatically starts circulator or burner when any valve is in open position. Brochure available.
Page 138 Item 259

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SUBSCRIPTION DEPARTMENT

TROUBLE-FREE CONDENSING..... and great power and labor savings are provided by the design of this manufacturer's condensers. Bulletin is available.
Page 140 Item 260

DRIP-TIGHT AND LEAK-PROOF..... seal is guaranteed on unions available from this company. Descriptive brochure is offered.
Page 140 Item 261

FAN ENGINEERING DATA..... are offered in pamphlet published by this company which discusses low cost heating plant power-draft and industrial exhausting.
Page 141 Item 262

ELECTRIC AIR DUCT HEATERS..... provide forced air temperatures to 1050 deg F. For space heating or for adapting present air conditioning systems for central heating. Installed quickly in round or rectangular ducts. Bulletin offered.
Page 141 Item 263

INSULATION ADHESIVE..... is specially formulated, and offers 30% savings on labor cost, a permanent bond, and a neater job. Catalog sheet and sample are available.
Page 141 Item 264

AIR-COOLED CONDENSERS ..... are re-designed and offered in a wider range. They also come job-ready for multi-circuit applications. Standard self-contained remote models, 3 to 25 tons. Information available.
Page 142 Item 265

GAS UNIT HEATERS..... are designed and built for long life and reliable service. Company offers a booklet entitled "Modern Heating."
Page 143 Item 266

EXTRUDED ALUMINUM SHUTTERS... are of modern design, light weight, fully weather-stripped, easier to install, and are rust and corrosion proof. Complete specifications available.
Page 143 Item 267

BOILER LEVEL CONTROLS..... are claimed to be the safest because they are simplest in construction. Controls have permanent magnet located outside float chamber eliminating mechanical parts normally subject to wear and fatigue. Catalog available.
Page 143 Item 268

PREFORMED FILTER..... is efficient, economical and convenient. Installation is no problem. Bulletin is available.
Page 144 Item 269

FURNACE CONTROL LINE..... includes furnace limit control and furnace fan control. The former is available either adjustable or non-adjustable, calibrated and pre-set to your specifications. Inquiries invited.
Page 145 Item 270

DUCT FANS..... in this installation take fumes up and out, saving valuable floor space in busy working area as compared with old, space wasting system. Bulletin is offered.
Page 146 Item 271

ATOMIC SUBMARINE..... Skipjack utilizes the manufacturer's instrument for temperature, pressure and humidity. Information is available.
Page 147 Item 272

ROOM TEMPERATURE CONTROL..... for all types of buildings provides accurate and independent control on steam or hot water systems. A modulating control, it is completely self contained, has no electrical connections. Information available.
Page 148 Item 273

FILTER-DRIER ..... incorporates an activated ceramic desiccant block for micronic filtration with granular desiccant for high efficiency drying at low pressure drop. Information is available.
Inside Back Cover Item 274

ENGINEERING DATA SHEETS..... give new and special applications of the manufacturer's controls for use with equipment including expansion and compression tanks, stand-by pumps and higher temperature hot water heaters. Use coupon in ad, not inquiry number, to get a set of these reference sheets.
Back Cover Item 275

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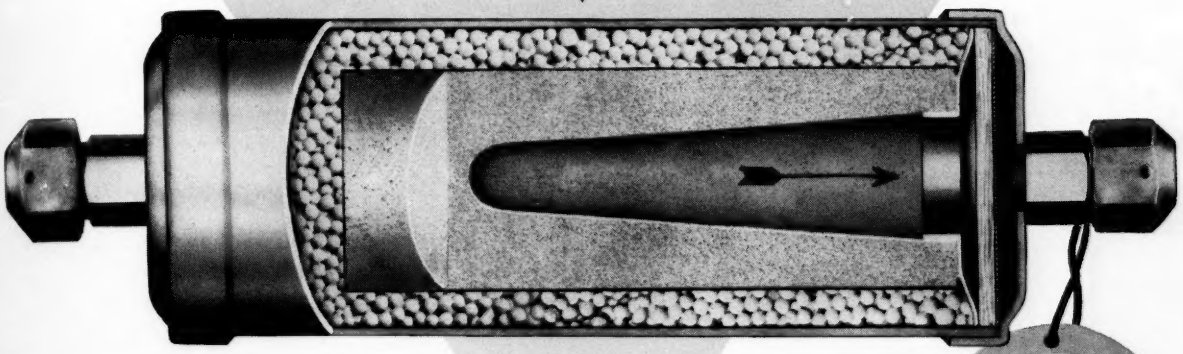

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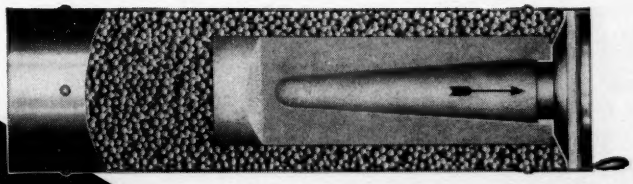

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